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APPLICATION OF THE CRITICAL PATH METHOD TO HIGHWAY DEPARTMENT FISCAL PROGRAMMING AND ADMINISTRATION OF BRIDGE PROJECTS

by

Alfred M. J. Keen

A THESIS
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled APPLICATION OF THE CRITICAL PATH METHOD TO HIGHWAY DEPARTMENT FISCAL PROGRAMMING AND ADMINISTRATION OF BRIDGE PROJECTS submitted by Alfred M. J. Keen in partial fulfillment of the requirements for the degree of Master of Business Administration

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ABSTRACT

A system using Critical Path Techniques is reviewed with respect to the problem of multi-project scheduling and allocating limited resources to competing activities. The CPM system was developed in relation to the operations of the Bridge Branch, of the Alberta Department of Highways. Each work group of this Branch was studied and a master network prepared. A sample fiscal program was planned and scheduled, based on the activities of the work groups. The problems involved in each of the phases of programming, namely planning, scheduling, reporting, and control, were discussed. The problems of implementation and the education of personnel were also considered. It was concluded that a CPM system could be a powerful tool for highway management to help solve its problem of scheduling and resource allocation.

ACKNOWLEDGEMENTS

The author wishes to express his thanks to the many people who co-operated so willingly during the preparation of this report. The entire staff of the Bridge Branch, Alberta Department of Highways, made the study possible by giving their time, much valuable advice, and criticism. Mr. E. J. Sanden and other management personnel of the Department gave approval to undertake such a study, and provided any information desired. Dr. R. Pinola, Professor of Economics at the University, took a keen interest in the study and gave guidance as well as constructive criticism.

The author also thanks the following organizations, who supplied research papers and private information: U.S. Bureau of Public Roads, Automotive Safety Foundation, Highway Research Board, Canadian Good Roads Association, Saskatchewan Department of Highways and Transportation and the Ontario Department of Highways.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE PAGE

CHAPTER I

INTRODUCTION

The Problem

Management of government departments is no longer a matter of individual effort. The vastly enlarged scope of work undertaken, as well as the increased complexity of the public works projects themselves, have challenged the conventional management techniques used by these departments. Planning and controlling the departmental programs has become a complex problem which will be further magnified as these programs develop more fully. This study proposes to demonstrate the application of the Critical Path Method (hereinafter abbreviated to CPM) to multi-project planning and scheduling of preconstruction activities within the Alberta Highways Department. By using the Critical Path Technique as the vehicle or tool, it is hoped that management can more effectively carry out its classically defined functions of planning, co-ordinating, directing, and controlling.

Importance and Limitations of the Study

One of the basic objectives of the Alberta Department of Highways is to provide the needed highway development in the most economical method possible, given the available finances. The main, district and local road systems in the

Province have been expanding at an accelerating rate to keep pace with population growth, industrial and agricultural development, and the steadily increasing volume of traffic, both pleasure and commercial. Besides planning new highways and bridges, the Department is constantly upgrading existing facilities to meet present day standards and needs. This expansion is somewhat evidenced by the approximate 7% increase in the Department's 1965 budget over the prior year.

In accordance with the expansion of highway facilities in general, the Bridge Branch is faced with an increase in the number and complexity of bridge projects. There is also a tendency toward an expansion in the scope of duties, as for example, the increased inspection of bridge component fabrication. Added activities often follow technological advances such as the use of completely welded superstructure components. The use of these components requires a much higher degree of fabrication control than those previously used. This expansion in the work load of the Branch results in an increased strain on management to efficiently organize and direct all aspects of its program of bridge design, construction and maintenance.

The work carried out by the Bridge Branch involves planning, design, supervision of construction, and maintenance of all bridge structures associated with the main, district, and local road systems. This general outline of

the scope of activities includes the related work of material ordering, inspection, and supply, as well as contract preparation and tendering. Complicating the scheduling and control of work activities, is the wide variance between projects as to size, type, and cost. Projects may vary from a simple culvert installation to a major bridge, from small timber structures to a large suspension or arch type bridge, and from very low cost structures to those costing in the millions of dollars.

In addition to the variance of time, cost, and manpower requirements between projects assigned to the fiscal program, planning and scheduling is further complicated by factors beyond the control of Bridge Branch management. The dependency of the Branch for relevant information being supplied by other branches can and frequently does upset the program schedule. Another major factor which complicates the programming process is the seasonality of construction in the Province. The dependence on the time of year places definite restrictions on the Branch with respect to scheduling work activities.

The combined effect of the trends and restrictive factors outlined above is a considerable strain on efficient and effective resource allocation with the techniques presently employed by the Bridge Branch management. Techniques presently used include a version of Gantt or bar

charting, with each of the work groups within the Bridge Branch providing information pertaining to scheduling dates for their portion of the work. This method has several disadvantages that become especially evident with the increased number and complexity of projects undertaken. First, the method does not indicate inter-relationships and dependencies between activities; second, it does not provide for detailed work activity breakdown; and third, it does not lend itself to periodic review and revision in a manner which allows alternatives to be tested.

This study is restricted to a detailed analysis of the preconstruction activities normally undertaken by the Bridge Branch of the Alberta Department of Highways. Restriction of the problem is justified for the following reasons. First, the time allotted to the development of a thesis would not allow the evaluation of a total departmental system; second, the author is most familiar with the objectives and activities of this branch; and third, by subdividing the operations of the Department into its functional branches allows greater ease of implementation of a CPM system. The organizational structure of the Alberta Department of Highways, as depicted in Figure 1 on page 5, includes the selective branches of Construction, Bridges, Maintenance, Surveys, and Planning. Such a functional breakdown presents the opportunity to adopt a

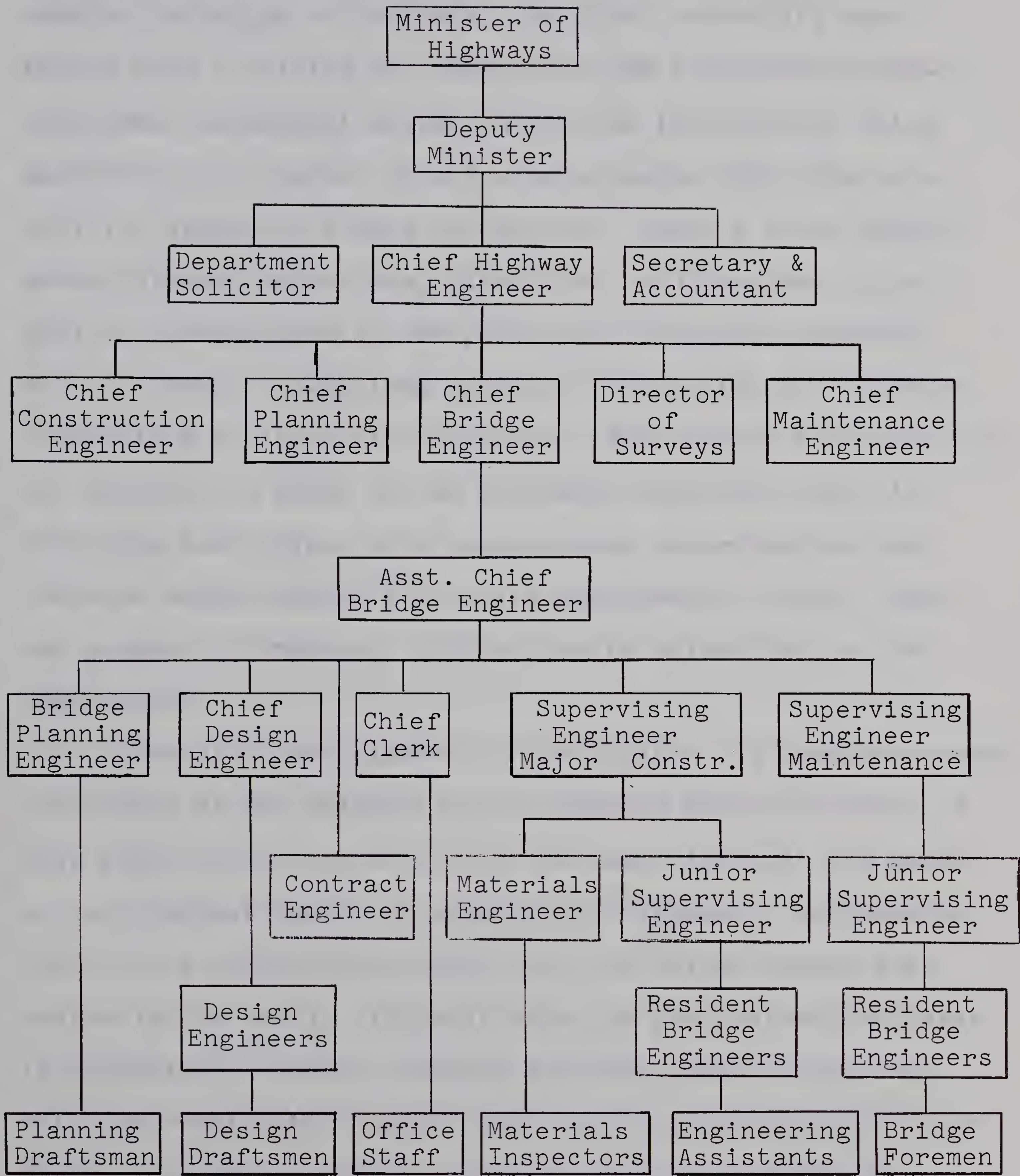
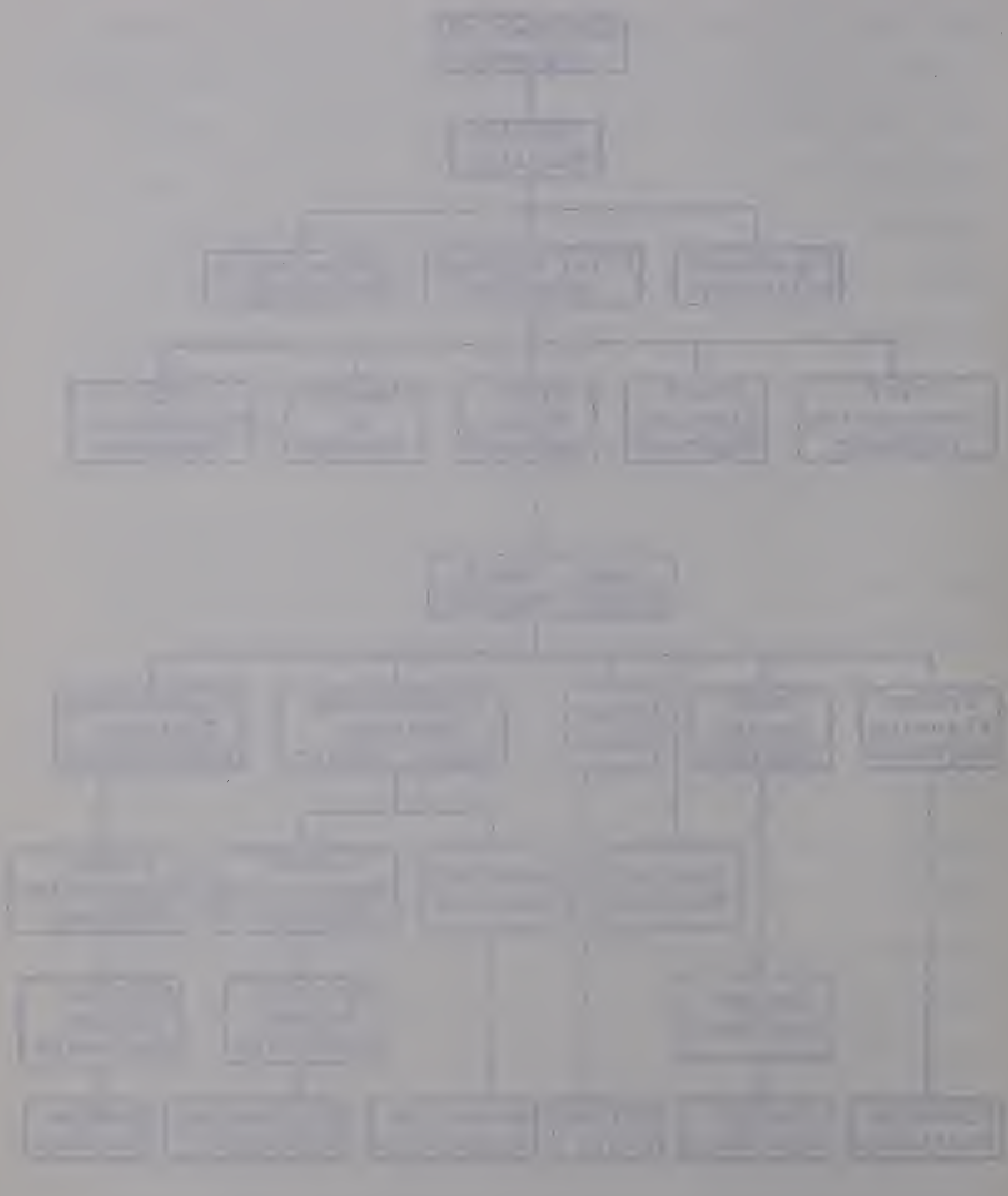


FIGURE 1. ORGANIZATIONAL STRUCTURE, ALBERTA DEPARTMENT OF HIGHWAYS, SHOWING DETAIL OF BRIDGE BRANCH ONLY.



modular technique of analysis. By first presenting each branch with a unified and compatible CPM sub-system, over-all department management needs can then be fulfilled by using macroscopic or limited detail type networks depicting major activity groups as single activities. Under a total departmental system, objectives, directives, and proposed plans will be communicated to the particular branches concerned and the branch sub-systems will in turn provide the relevant information to the master schedule. Each branch will evaluate its schedule in terms of the allocable resources under its direction and review, with inter-branch co-ordination and revision being carried out at the departmental level. Once the program is underway, control can be maintained in the same manner.

The study was limited to the analysis of preconstruction activities of the Bridge Branch primarily because control of this phase of the operations is the most difficult and leads to the greatest number of scheduling slippages. Implementation of the construction phase into the Bridge Branch subsystem is not unduly difficult once the preconstruction phase is operative. However, several problems arise in dealing with the construction phase which in themselves provide scope for special study. The most important is the degree of control and influence that the Department may reasonably exert upon independent contractors. Large Defence and Armed

Services contracts generally require detailed network plans and a CPM schedule to be submitted by contractors bidding for the work. In order to comply to these stipulations contracting firms must divulge detailed and sometimes confidential information of their operations. Such requirements are accepted when the contract involves sums of public funds in the millions of dollars. However, when contracts involve only a hundred thousand dollars or less, government intervention into the management of private enterprise may not be so well accepted. This problem will not be dealt with in the thesis.

Definitions of Terms Used

It is assumed the reader has some familiarity with traditional planning and scheduling techniques such as Gantt charts and the network planning techniques. Some basic principles and definitions of network analysis, however, are included below.

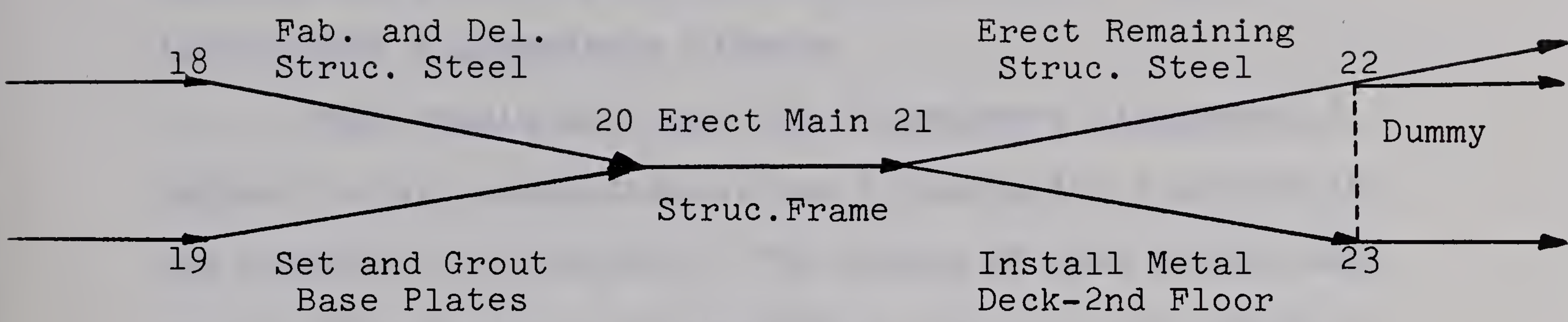
There are numerous network planning techniques available for management use today. Among these are the Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Resource Allocation and Multi-Project Scheduling (RAMPS), Resource Planning and Scheduling Method (RPSM), as well as a host of other variations. All the techniques and variations are basically structured on the same principles, namely, use of a network diagram to lay

out work activity relationships, employment of the time dimension for scheduling, and superimposition of resources to facilitate efficient allocation. There are, however, minor differences between the methods. For example, CPM uses one time and one cost estimate for each activity. PERT/COST is an extension of the PERT method to include cost-time relationships. Use of three time estimates for PERT activities allows for uncertainty in estimating job or activity durations. RAMPS goes beyond PERT and CPM in that it introduces competition among activities for a given resource and handles the problem when more than one project is involved. In actual development, the two allied systems of CPM and PERT have tended to merge. Original users of PERT based their calculations on the probability of occurrence of events, but the stress has changed to basing calculations on the start and finish of activities such as is used in the CPM technique. Moreover, in recent years the allocation of resources by physical rather than monetary value alone, has become important for all techniques.

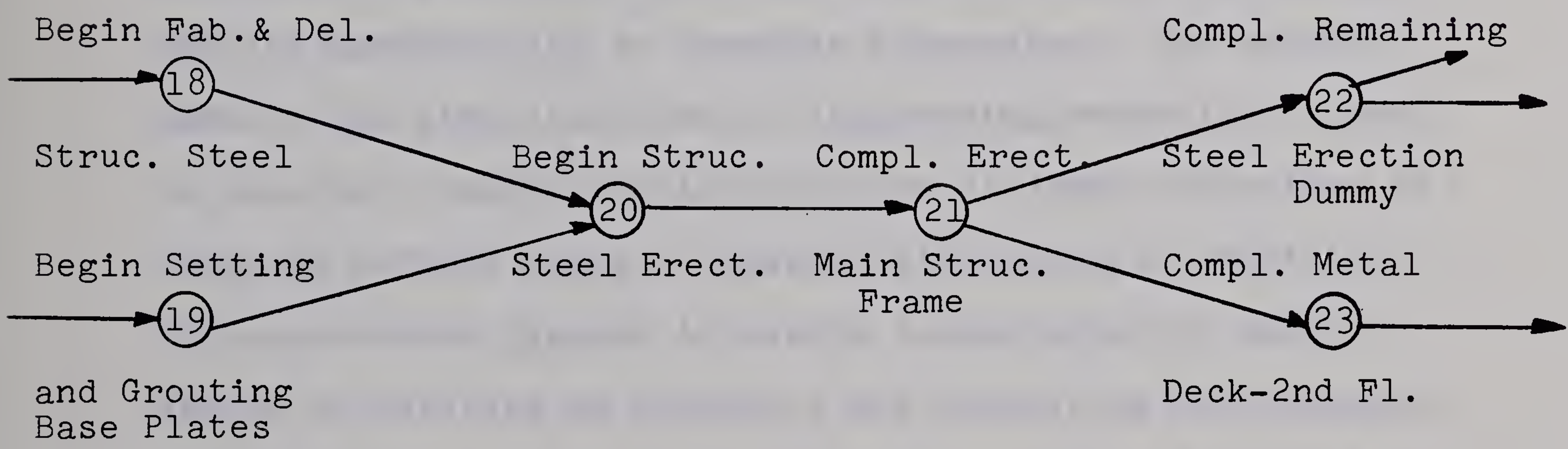
The network is a logic diagram or flow chart which identifies activities and events, interfaces, relationships, and constraits for a project or program. It is a graphic description of the plan showing the sequential steps needed to reach a stated objective. There are several possible systems for network diagramming. The two that are the most

common by far, are the activity-labeled arrow diagram and the event-labeled arrow diagram. In both of these systems, each individual activity or job is represented by an arrow, with the beginning and end of the jobs defined as events. The difference lies in whether the diagrammer wishes to emphasize the activities or the events. Figure 2 on page 10 illustrates the two methods. An event corresponds to a moment in time whereas an activity represents work and is a time-consuming function. The events in the network are termed nodes and represent that point in time when all activities terminating at the node are complete and the activities leaving the node may get underway. A dummy activity is represented by a broken arrow, and is used primarily to create an artificial node to maintain the proper sequence of jobs. The dummy activity takes zero time and establishes an interdependency of two activities. Constructing a network, such as is illustrated in Figure 2, necessitates logical and sequential labelling of activities and events showing pertinent interrelationships.

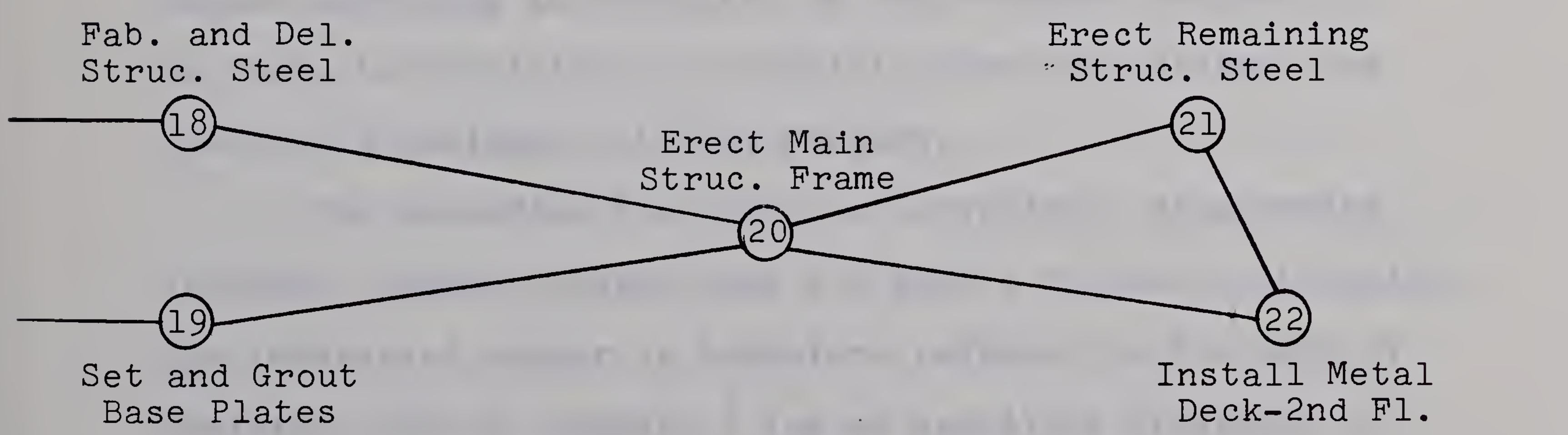
A third system of network diagramming which is becoming more and more popular is termed "precedence diagramming". For this system, activities are represented by single numbered nodes and are connected by precedence or sequence lines to other nodes representing preceding or following activities. Like the activity labeled arrow



(A) Activity-Labeled Arrow Diagram



(B) Event-Labeled Arrow Diagram



(C) Activity-Labeled Precedence Diagram

FIGURE 2. NETWORK DIAGRAMMING METHODS

diagram, this is an activity-oriented system. Figure 2 illustrates a precedence diagram.

This thesis will use the "precedence diagramming" method for all computational and illustrative purposes in the remainder of the text. The choice of this system was made for the reasons of simplicity, the ease of revision of the network, the use of singly numbered activities, the calculation procedures allow the use of random numbering, and its adaptability to computer processing. The method permits the simplification of diagramming mechanics in that it does not require the introduction of dummy activities in order to portray correct network relationships. Revision of a precedence diagram is easily accomplished by simply adding or deleting an activity, and correcting the sequence relationships, without disturbing the existing diagram to any extent. Because activities are singly numbered and random numbering is permitted by the computer program to be used, the addition of an activity does not disrupt the previously assigned activity numbers.

The preceding discussion of precedence diagramming is short, however, space does not permit further elaboration. The interested reader is therefore referred to the work of Professor John W. Fondahl [1] for an excellent treatment of

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[1] Fondahl, John W. Methods For Extending The Range of Non-Computer Critical Path Applications. Technical Report No. 47, Prepared for the Bureau of Yards and Docks, U.S. Navy. Stanford: Department of Civil Engineering, Stanford University, 1964.

this system of network diagramming.

The critical path is the chain of successive activities which contribute directly to the overall duration of the project, the activities on this path being called critical activities. Losses or gains in the duration of any of the critical activities will affect the total project duration by this amount. Once normal activity duration times are placed on the network, earliest activity start times can be calculated beginning at the first activity to be undertaken. This is the earliest time that an activity can start and is equal to the earliest finish time of the preceeding activity or group of activities. The earliest finish time of the last activity in the network gives the total project duration time. Once the forward time calculations are completed, backward calculations are then carried out to determine the latest start time and the latest finish time of the activities without delaying the project duration. These calculations are started at the last activity to be completed with the latest finish time set equal to the earliest finish time for this activity. Activities on the critical path will have earliest start and latest start times that are equal, that is, there will be no "time to spare" for these jobs. On sub-critical paths there will be "time to spare" relative to the established completion date and this extra time is called slack time or float.

There are various categories of float, each with individual meaning, derivation, and application. The three main categories are total float, free float, and independent float. Total float is the amount of time that an activity can be lengthened without delaying the completion of the over-all project within the following time frame. All preceding activities which influence the given activity are completed as early as possible, and all succeeding activities which are influenced by the given activity are started as late as possible. Total float may be calculated for a given activity as equal to the difference between its early and late start times.

Free float is the amount of time that an activity can be lengthened without affecting the earliest starting times of all activities immediately following it and is calculated for the following time frame. All preceeding activities which influence the given activity are completed as early as possible and all succeeding activities which are influenced by the given activity are started as early as possible. For a given activity, free float may be calculated as the difference between its total float and the total float of the succeeding activity. In the case of multiple succeeding activities the one with the smallest total float value is used.

Independent float is the amount of time that an activity can be lengthened without changing either the latest completion

times of preceeding activities or the earliest starting times of activities immediately following, within the following operating time frame. All preceeding activities which influence the given activity are completed as late as possible and all succeeding activities which are influenced by the given activity are started as early as possible. Independent float is not affected by other activities.

Since float is a path concept, even though it is calculated on an individual activity basis, it can be of great value in preventing program imbalance resulting from over-concentration of resources on any single path of activities. Float may be used to regulate the workload within various sub-parts of a department and it provides the flexibility required for scheduling resources to a project.

Organization of the Remainder of the Thesis

The remainder of the thesis will deal with the following topics: (1) An overview of the literature relating to highway planning methods, (2) the general use of network planning methods, and (3) the use of network planning methods in highway departments. As such a flood of literature on network planning methods has developed in the past few years, only those articles and books pertaining to the topic of highway applications will be dealt with to any length.

A network model will be developed depicting the preconstruction activity relationships of the Bridge Branch of the Alberta Department of Highways. This model is based on the detailed work activity analysis of the functional work groups of this Branch and,as such,is the core of this thesis.

In addition, a hypothetical fiscal program for the Bridge Branch will be planned and scheduled to illustrate various aspects and problems of resource levelling, reporting, and control. Other factors such as the creation of a data bank, and the education of personnel will be discussed.

CHAPTER II

REVIEW OF THE LITERATURE

Much has been written in regard to planning and scheduling highway construction program. However, only a brief summary of the work very closely related to the problem at hand will be outlined.

Literature on Highway Planning Methods

A great deal of information regarding programming and scheduling procedures is available in the form of published material from a number of highway departments in the United States and in Canada. For the most part, this material, with added information obtained by personal interview with Highway officials, is summarized in a report presented at the January 1963 meeting of the Committee on Highway Programming of the Highway Research Board.[1] This report emphasizes the execution or administration phase of the programming process by reporting available essential details of scheduling, and control methods and procedures. Only incidental attention is given to the basis for making decisions on the priority of projects in an extended program.

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[1] A Review of Scheduling Procedures for State Highway Construction Programs. Highway Research Record, Number 32. Highway Research Board of National Academy of Sciences -- National Research Council. P.1.

The report referred to above is limited to analysis of highway department procedures of thirty-five states in the United States and thus it gives an indication of the types and sophistication of programming procedures in use at that time. The data is given in carefully condensed factual reports and is classified on a functional basis covering the areas as follows:

A. Highway Program Formulation

1. Apportionment of funds
2. Basis for project selection
3. Financial schedules of available funds
4. Program formulation

B. Highway Program Administration

1. Time schedules for precontract engineering
2. Control and adjustment of time schedules for precontract engineering
3. Control and adjustment of expenditure schedules

Because of the differences between the Canadian and United States systems of fund allocation and the federal-provincial, federal-state relationships, the financial and expenditure aspects of the report do not relate closely to the problem of this thesis and will not be dealt with further. The program administration aspects of scheduling and controlling precontract engineering do, however, relate closely, and these general findings outlined in the report are considered below.

It was found that 14 of the 35 states maintain schedules of letting dates for at least the oncoming program year. Only 5 of these 14 attempt to schedule letting dates for a second year in advance, and only 2 of these schedule 3 years or more. In some states a formal schedule of some generalized precontract engineering activities has been established. The activities vary from a basic list (location survey, plan preparation, and right-of-way acquisition) to multiple lists of considerable complexity. Some states use the bar chart to portray both inception and completion of each engineering activity; others use Kardex files to record only estimated and actual completion dates.

The committee found that few if any states used effective methods of scheduling manpower. Time required to carry out precontract activities is generally based on personal judgements without the benefit of work measurement analyses. The task of scheduling a multi-project program is a complex undertaking which involves the interaction of the financial schedule, engineering manpower requirements, and engineering manpower available. The control and adjustment of the schedule is a similarly complicated task.

The concensus indicated from the report is that none of the state highway departments considered has fully utilized their resources such that:

1. Each programmed project is analyzed to accurately detail and arrange sequentially the various engineering activities;
2. An estimate is made of total time and manpower required to accomplish each activity;
3. Projects are compared and shifted in time to maximize the use of manpower resources.

Literature on Network Planning Methods

Development of the CPM and PERT techniques was largely a result of the refinement of older management aids. These techniques and the newer refined variations of them, have rapidly evolved since about 1957. All the network planning techniques are basically structured on the same principles, but differ in their emphasis on particular aspects of control and resource allocation.

Since the time of development, network planning techniques have found a wide range of use. A large number of papers and articles regarding the use, theory, and limitations of the techniques has filled trade magazines and business publications in the past few years. A number of these articles are listed in the bibliography.

Industrial and commercial applications of network planning techniques are increasing steadily. Research and development programs, construction programs, preparation of bids and proposals, maintenance planning, new product

launching, budget planning, and distribution planning are but a few areas where these techniques are currently being used. The construction industry, whether it be buildings, equipment, or bridges is one of the most fruitful of fields for the application of network planning methods.

The most spectacular and detailed application of these techniques is by the United States government for planning, scheduling, and controlling weapon systems development and space travel programs. The Department of Defence, National Aeronautics and Space Administration, and the Departments of the Army, Navy and Air Force have largely been responsible for the advancement and refinement of these techniques. A number of publications by these agencies are listed in the bibliography.

Literature on the Use of CPM for Highway Programming

The use of network planning techniques for programming and controlling highway development is rapidly increasing with a great deal of interest being shown by highway management personnel. Presently, several state highway departments in the United States have applied the network planning methods to schedule various aspects of their highway programs. The State of New Mexico is using CPM for scheduling preconstruction engineering, while other states are using the technique to schedule and control the construction aspects as well.

The United States Bureau of Public Roads and the Automotive Safety Foundation have largely been responsible for the impetus and renewed effort regarding highway planning. These agencies have sponsored a number of research projects regarding the problems of applying the network planning methods to highway department engineering and administration. The Automotive Safety Foundation sponsored a study relating to the possible use of network planning techniques for highway project programming in 1962. The report of the study, entitled PERT and Its Application to Highway Management, was presented at the 42nd Annual Meeting of the Highway Research Board in January 1963.[2] This study was conducted in co-operation with the Washington State Highway Department. The investigation included the application of PERT to the preconstruction activities of this department from the inception of projects into their biennium budget until the projects were advertised for construction. The study only carried the application to the stage where critical events were determined, milestone events scheduled, and total project time obtained. Nothing was attempted in the way of resource allocation or recycling to account for resource deficiencies. The report concluded

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[2] Grunow, Robert N. PERT and Its Application to Highway Management. Highway Research Record, Number 32. Highway Research Board of the National Academy of Sciences -- National Research Council. P. 38.

that network planning tools have excellent possibilities in being successfully applied to a group of isolated projects which comprise a single annual continuing objective, such as a highway program. The author indicated that if nothing else is done except development of the network, the benefit to top management is positive in that it shows the interrelationship of a phase of work to the entire amount of work to be produced.

A more recent publication entitled "Multiproject Scheduling for Highway Programs" was a result of a two-day workshop sponsored by the Automotive Safety Foundation. The purpose of the workshop was to bring together men who were working toward improved concepts of work organization and government and highway officials in a setting where they could share some of their progressive ideas, theories, and experiences. The goal was to help resolve one of the most vexing problems of highway departments, how to meet management's priority objectives on time through better methods of allocating limited manpower well in advance to competing preconstruction activities.[3] The workshop dealt with most of the important aspects of highway planning and the problems

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[3] Multiproject Scheduling For Highway Programs. Proceedings of a Two-Day Workshop Sponsored by the Automotive Safety Foundation. Washington, D.C. December 1963. P. IV.

of designing and implementing an integrated management system. A great deal of information was exchanged and a number of interesting viewpoints were presented, which serve to define the common objectives and act as a guide to future research in the application of planning methods to the highway programming field.

Besides the research and development undertaken by the U.S. Bureau of Public Roads itself, this agency has contracted consulting firms to undertake research to explore and evaluate the Critical Path Method in highway engineering and administration and to develop detailed procedures for this application. Much of this work is being carried out at the present time and little of the resulting information is readily available.

Much less has been done in Canada with regard to the use of network planning techniques for scheduling highway programs. The Ontario Department of Highways has used CPM for scheduling design and construction of a large expressway project which included several bridge structures and a substantial portion of highway work. The Quebec Department of Roads is using multi-project scheduling for the design and construction of the freeway network that is to be completed before the Montreal World's Fair. In Nova Scotia, CPM has been used to schedule and control typical grading and paving contracts. The main use to date of network planning in this

Province has been aimed at estimating the completion dates for contracts. The Saskatchewan Department of Highways and Transportation has adopted the Critical Path Method to undertake multi-project scheduling. The prime objective of this Department was to keep the supervision of increasingly complex operations within the scope of human capability and to provide all levels of management with meaningful, up-to-date information. They have organized a staff unit responsible for the development of systems to be followed in scheduling the work of the Department, monitoring progress and providing management with information essential to effective operation. The approach taken to institute multi-project scheduling has been to develop a master network diagram which can be related to each project in the highway program, and which is structured from basic component networks according to the unit or organization responsible for performance. This Department has concentrated its attention on its internal operations and as yet has not attempted to expand the network development to the construction operations. They are working toward eventual establishment of total multi-project scheduling of all Departmental operations.

CHAPTER III

WORK STUDY OF THE BRIDGE BRANCH, ALBERTA DEPARTMENT OF HIGHWAYS

General Considerations

Any activities conducted by a successful organization should start with the identification, definition and organization of its objectives. All prime and supporting objectives should not only be clearly spelled out but must be communicated effectively to operating management.

Highway departments set up as a public service are responsible for the development of highways and related facilities consistant with public needs. This highway development and improvement must be undertaken by the most rapid and economical methods possible. Thus defined, top level highway management's responsibility includes the long-range planning of an integrated highway system which will best serve the present and probable future development of the Provinces' resources. Since highway facilities are a long-term investment, planning must of necessity include long-term projections of future requirements. Needs studies must not only deal with present circumstances but must be projected to take account of such factors as probable population growth and movements, natural resource discoveries

and development, traffic growth and other economic indicators.

Once assessed, the necessary main highway, district highway and local highway requirements need to be integrated and subsequently scheduled into a highway program. Since a highway department, like any other business entity, is limited in the amount of financial and other resources available to carry out its program, procedures are required to schedule projects according to their relative priority ranking. The limitations of time, money, manpower, and equipment thus define the boundaries within which project planning must fall. The problem is, therefore, to make maximum use of these limited resources.

To facilitate the integration and consistency of the program objectives of the Alberta Department of Highways, a breakdown of work requirements was constructed. It was developed downward through successive levels of management to the level of detail thought necessary for effective program management. Such a work breakdown was necessary to establish the basis for defining the work to be performed in successively greater detail, to determine how the various end items of work are related to the program objectives, to identify the organizational units responsible for accomplishing the work, to enable summarization of actual status and forecasted progress of the program, and to enable the construction of networks at any desired level of detail. Figure 3 on page 27,

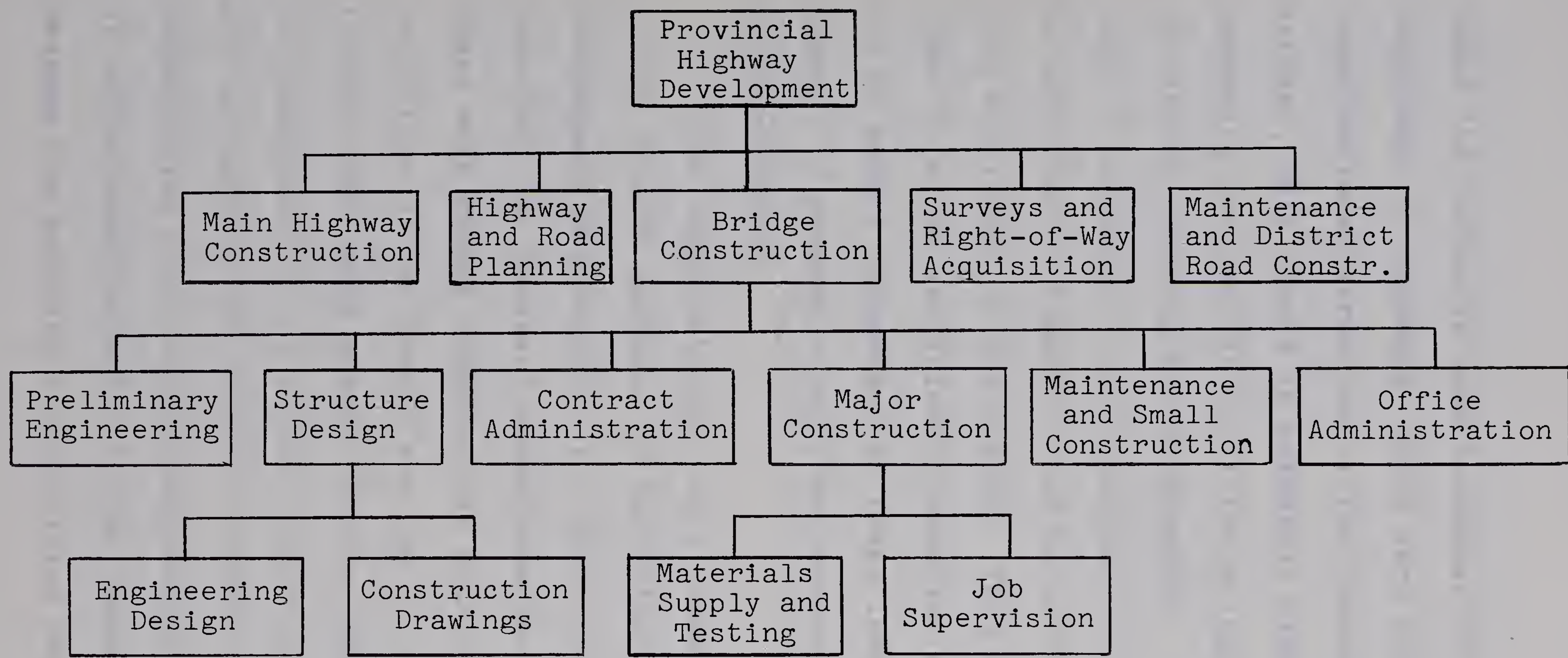

FIGURE 3. WORK BREAKDOWN STRUCTURE, ALBERTA DEPARTMENT OF HIGHWAYS, SHOWING DETAIL OF BRIDGE BRANCH ONLY.

shows the tentative work breakdown structure of the Alberta Department of Highways, which very closely reflects the organizational structure of the Department. As was explained earlier, this thesis is primarily directed toward mapping and examining the activities of the Bridge Branch in the context of network planning and programming. Emphasis is on the Level 2 and Level 3 organizational units of the Bridge Branch, as indicated in Figure 3, and in particular to the preconstruction activities of the Branch. This delineation was made in order to allow sufficiently detailed networks to be constructed and to enable management at these levels to concentrate on the aspects of program control and co-ordination for which they are responsible.

The organizational units chosen to represent the work groups or work packages of the Bridge Branch are: (1) Preliminary Engineering, (2) Structural Design, (3) Materials Ordering, (4) Contract Administration, and (5) Construction. These work groups comprise the bulk of the preconstruction activities of the Branch and can be further subdivided to include other work groups such as right-of-way purchase. The consideration of actual construction activities which are included in the study is limited to those showing inter-dependencies with the preconstruction activities. The work of office administration is not considered in this thesis because the majority of activities performed are of a

clerical nature and do not materially affect the bridge program at the level of detail considered feasible for the networks. There is room, however, to seriously look at the activities of this work group as a supplement to the thesis. The work activities necessary for bridge maintenance are also excluded, as they do not form a major part of the fiscal program dealing with the scheduling of new projects. This area, however, offers an excellent opportunity for the use of CPM in programming a routine maintenance program. As the highway system grows and the number of bridges steadily increases, a co-ordinated maintenance program will become necessary, not only to keep up to the volume of work, but to more efficiently schedule work crews in performing repairs and improvements.

Descriptions of the activities undertaken by each of the work groups were developed through discussions with the personnel whose responsibilities fall in these areas. These activity descriptions are noted in detail in Appendix A. Networks were then developed for each organizational unit which are based on the described activities and indicate the precedence of jobs as well as interdependencies between them. From the individual component networks, a composite or master network, (shown in Appendix A), was developed to incorporate all conceivable activities which may be required for the

execution of a project. This approach is somewhat different from the one-of-a-kind networks used frequently for specific projects such as a plant expansion. Development of a unique network for every project would be a formidable task when you consider the multitude of individual projects which go to make up a long range program for highway development. If this was the case, the cost of developing the networks might well outweigh any potential savings to be realized.

Use of a composite or master network, such as was developed for this study, has several advantages when dealing with a number of projects involving similar activities, as in the case with the work of the Bridge Branch. Although projects vary as to scope, size, time required for completion, and the activities involved, all that is necessary to reflect the requirements of each specific project is to modify the master network. If computer processing is planned as an eventual aid for scheduling, it is desirable to have a uniform activity numbering sequence applied to every project. Use of a master network allows retention of the node numbering sequence and adaption of the network to reflect a specific project is accomplished simply by assigning a duration time of zero to any activities which do not apply. Projects requiring special or extra activities can as well be programmed by the insertion of the activities and dependencies into the master network. Using a master network thus reduces

the probability of neglecting an important activity when a project is being planned.

Although the variance between projects is extremely wide, certain features of bridge projects make it possible to categorize structures according to type, size, and usage. One possible method of categorization and coding is found in Table I on page 32, and will be referred to in the remainder of the thesis. Being able to categorize in this manner materially aids planning and scheduling a fiscal program as well as establishing a basis for the development of a data bank of time, cost, and manpower requirements for each activity in the master network.

Preparing the fiscal program for the Branch is a rather complex aspect of the work, as many variations exist depending on the projects being considered for the program. During the period of this program preparation, there is a wide range in the work already completed on different project proposals. This work may vary from nothing to completion of the reconnaissance report and design data drawings. Some projects are more likely to be approved than others, thereby allowing the planning staff unit to work ahead on these high priority projects. Besides permitting a more comprehensive study of these projects, this factor also gives management a firmer basis on which to schedule a fiscal program.

TABLE I

BRIDGE STRUCTURE CATEGORIZATION (CODING)
for
IDENTIFICATION IN NETWORK PLANNING

General Code

S	Bridges
T	Overpass Structures
W	Other (Pedestrian overpasses, livestock underpasses)

Primary Code

R	Major River (Require Navigational Waters Act Approval)
P	Stream
U	Railway
H	Highway
C	Urban

Secondary Code

10	Steel
20	Concrete
30	Timber

Minor Code

01	Rolled girder - simple
02	Rolled girder - continuous
03	Rolled girder - cantilever
04	Truss - deck or through
05	Welded girder
06	Frame
11	Precast girder - simple
12	Precast girder - continuous
15	Precast girder - standard
16	Slab
19	T girder
20	Box girder
22	Glulam
23	Treated timber

Programming bridge projects is a function of the Chief Bridge Engineer and involves the work of integrating all bridge requests coming to his attention, communicating with the staff heads and other branches of the Department concerning future plans, and outlining project priorities as a result of his study. These activities usually entail Branch and Department conferences and, of necessity, require constant communication with these parties regarding long-range highway development plans. Because the Bridge Branch is influenced by this type of internal restriction, some difficulties are encountered in scheduling preconstruction activities. There have been many instances in the past which involved deleting a project or adding a project to the program and which necessitated a complete review of the schedule. Presently there is no sound method of projecting the effects of such a change in order to produce a revised schedule that is justifiably realistic, and which allows alternate courses of action to be assessed.

At this juncture, it might be advantageous to explain that for many activities, the work outlined may well have to be done several times before it is accepted and approved. This recycling of activities is not shown in the network as it is a separate qualification more related to updating the system and the program schedule. Because doing a certain activity over is not a normal event in carrying out the project, the only effect is to delay the schedule. For this reason, it

is advantageous to be able to see the effects of such a happening on the total program schedule and to apply corrective action at the time of its occurrence. There are many activities that may require recycling, such as redoing cost estimates, redoing a portion of the reconnaissance report, or preparing alternative structure designs, to name a few. The dynamic nature of the work of the Bridge Branch and the many variables concerned necessitate periodic reviews of the program and subsequent updating of the schedule. To do this effectively, management must have a method allowing them to project alternative proposals to form a basis for decision.

The Functional Work Groups

As was noted earlier, the organizational units chosen to represent the work groups of the Bridge Branch included (1) Preliminary Engineering, (2) Structural Design, (3) Materials Ordering, (4) Contract Administration, and (5) Construction. For each of these work groups, objectives and responsibilities were outlined and a list of activities was developed. An attempt was made to identify all conceivable activities relating to each group and to place them in their logical order of performance. This procedure is not as simple to accomplish as stated above, since it depends on how finely activities are divided. The degree of refinement desired is

that which is necessary to adequately describe the working technological sequence.

Preliminary Engineering Unit. The preliminary engineering activities described in Appendix A, and as outlined in the network are carried out under the administration of the Bridge Planning Engineer. He heads up the planning staff unit, has functional authority and is responsible to the Assistant Chief Bridge Engineer. The main responsibility of the Bridge Planning Engineer is to assess bridge requests coming to his attention and to administer and co-ordinate the engineering activities required to prepare a reconnaissance report and drawings along with alternate proposals and recommendations of the most desirable course of action. His report and recommendations come before top management for approval.

Requests for bridge structures within the Province originate from various sources as may be seen from Figure 4. The greatest percentage of bridge requests that are dealt with by the Bridge Planning Engineer are a part of the Department's future highway system program.

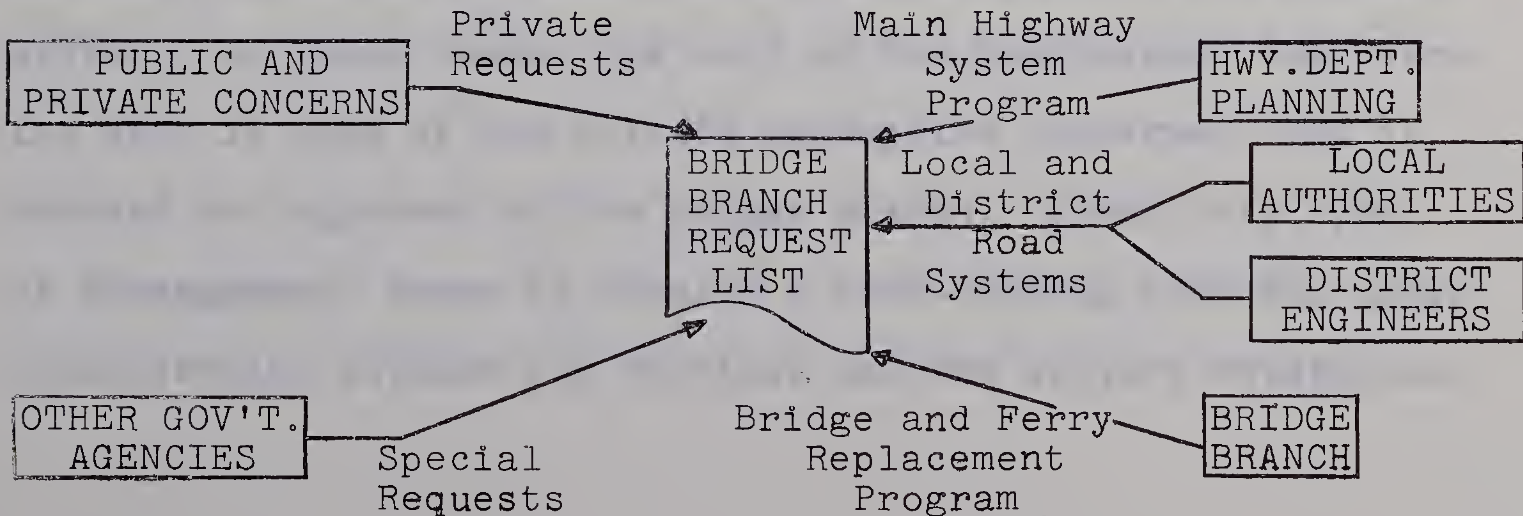

FIGURE 4. SOURCES OF BRIDGE REQUESTS

A large number of bridge project requests are originated by local government authorities as well as district engineers. Municipalities and Counties present request lists to the Department outlining the bridge requirements consistent with the development and construction of local road systems under their jurisdiction. District engineers in the employment of the Department report on bridge requirements for district and secondary highways as well as for Improvement Districts under their jurisdiction.

Many projects planned by the Bridge Branch are generated from within the Branch itself. Present facilities are constantly being assessed from the viewpoint of standards and maintenance, with many projects coming up for reconstruction. The ferry replacement program constitutes a major source of bridge projects generally in the major structure category.

Although the number of public or private enterprise requests reaching the Bridge Planning Engineer is not substantial, the requests must be considered, assessed and planned as any other project requests. In this group are requests by private companies wishing to construct bridges mainly for their own use, but which at sometime may become part of the highway system. In these cases, the bulk of the preliminary engineering work is done by the private enterprise concerned, but is checked and approved by the Bridge Branch. Under this type of arrangement, there is usually a cost-sharing proposal under consideration between the Province and the private enterprise.

When highways pass through or around urban developments, the cities concerned usually proceed with preliminary engineering and design. These types of projects generally include cost-sharing considerations and the Branch is concerned with project approval at certain milestone events.

Although the differences described above, with respect to the sources of bridge requests, are not directly portrayed on the network diagram, they must be considered during the scheduling of a program. Because the content of the work undertaken by the Bridge Branch varies according to the source of the request, this must be considered when assigning resources and time estimates to the necessary activities.

Shown as part of the preliminary engineering section of the network is right-of-way aquisition and approach-road design. At the present time, right-of-way purchase is handled in three ways. First, for main highway projects, right-of-way is requested by the Construction Branch and is purchased by the Survey's Branch, secondly, for bridges on local and district roads, the local authorities are requested to purchase right-of-way, and thirdly, for some projects on district highways or local roads, the Bridge Branch requests the Survey's Branch to acquire right-of-way rather than the local authorities. Approach-road design is undertaken on major river or stream crossings for projects not on a main

highway system. The purpose is to provide a high standard approach to a bridge structure when municipal authorities cannot afford to do so. Presently this function is being carried out by the Construction Branch of the Department with the design being approved by, and the construction financed by, the Bridge Branch.

Small standard type bridges and culverts are one category of requests not suited for scheduling in the fiscal program according to the CPM system. Insofar as final planning is affected, these types of request are bunched into one group and a set sum of money allotted to supply the materials and perform the work involved. The maintenance and small structure staff assume the responsibility for rating the priority of requests falling into this category and seeing that they are undertaken.

Structural Design Unit. All activities involved in structural design and preparation of working drawings for a project are carried out by the design staff unit. The work of this unit is dependent upon the reception of approved design data drawings from the preliminary engineering unit with the exception of grade separation projects. In these cases, drawings consisting of highway profiles and alignment plans are prepared by the Construction Branch. Because the Bridge Branch does nearly all the bridge design for the

provincial highway systems, there is a wealth of experience and information available with regard to bridge types, design standards, costs and other structural design considerations. This information provides a good basis for preparing cost estimates and planning bridge types during the fiscal program planning stage.

The Chief Design Engineer, as head of the design staff unit, is responsible for co-ordinating the structural design program in accordance with the objectives of the Branch's fiscal program. Achieving this objective includes administrative duties with regard to work methods, office procedures, and specialized projects. The greatest portion of his work involves supervision and scheduling of design and drafting activities, advising on bridge structure types, specifications, and special design problems, and preparing cost information. His contribution to the planning of the fiscal program is to aid in predicting feasible bridge types for particular projects. The ability to forecast a bridge type for a project that is being considered on the fiscal program depends upon the amount of preliminary engineering information available at the time of planning, and the experience with similar size structures at similar locations.

Because the fiscal planning function of the Branch is carried out well in advance of the actual design, it is extremely likely that alternate bridge types may prove more

economical. As the preliminary engineering is completed and as the designs undertaken, specific problems and details will frequently come to light necessitating changes to be made from the original thoughts on structure type. As well, there will undoubtedly be requests from top management of the Department for revisions in the program. The dynamic nature of the program presents many problems in scheduling the projects and maintaining an even work load on the design staff. For this very reason, a method is required which will facilitate program scheduling by allowing simulation of alternatives and hence provide management with a basis for making decisions.

The design unit portion of the master network depicts the activities required to attain the objectives of the design staff unit. Interlaced with this portion of the master network are dependencies on other staff units of the Branch as well as with higher level management. The network includes all activities required to complete the structural drawings of a project from the time the design data information is received in the design office. Although higher management levels know the probable bridge type and approximate costs of a project during the time of planning and scheduling the program, formal approval or approval to continue is generally obtained during the preliminary activities of design. Decisions at this juncture are based on proposed structure alternaties, substantiated by rough drawings and greater detailed cost figures.

Work of other staff units is also dependent on the completion of certain activities by the design work group. The materials ordering and inspection phase of total project work is dependent on the design work group completing certain activities. Superstructure drawings are required to be complete before requisitions can be prepared and the materials supply firmed up. Miscellaneous materials ordering is dependent on the completion of a set of structural drawings for the project.

It has been a general practice in the Bridge Branch to assign only one design engineer to each project provided the project was not exceedingly large. All the structural design activities necessary to complete any project, including the checking of drawings, are therefore completed in a consistent manner throughout. Similarly, the structural design checking is performed by some other design engineer. This practice, however, is not followed during the drafting phase of the design units' work, and as many as four draftsmen may be assigned to complete the drawings for a particular project. These considerations are important to bear in mind when provisions are made to even out the work loads of the fiscal program.

Materials Ordering Unit. Within the present operating system of the Bridge Branch, certain activities are undertaken to supply various classes of materials for the bridge

construction program. Materials supplied by the Branch include those which are basic to the structural soundness of a bridge, those for which a reasonable amount of control is necessary on supply in order to allow construction scheduling, and those for which large lot purchases presents cost savings to the Department as a whole. Table II on page 43, lists the items generally supplied through the Branch for the various categories of purchase.

Job lot supply includes those materials that are not standard from bridge to bridge and which necessitates rigid inspection to ensure that specifications and hence structural soundness is met. Control of the supply schedule also allows the Branch the flexibility to co-ordinate material supply with other activities besides obtaining considerable time savings in total project duration.

Materials that are supplied through stock advance on an inventory basis include those which are standard from project to project, and which prove economical to order in large lot sizes.

Reinforcing steel and standard precast concrete girder units are presently requisitioned on an inventory basis with storage by the fabricator. Job orders are billed against the requisitioned inventory as required. This method of ordering allows the Department the economies of large lot purchase as well as control of the supply scheduling.

TABLE II

MATERIALS SUPPLIED BY THE DEPARTMENT

Type of Supply	Materials
Job lot basis for specific structure. Requisition to Purchasing Agent for each order.	1. Superstructure - steel, precast concrete, timber. 2. Handrail, handrail anchors. 3. Miscellaneous iron - expansion assemblies, buffer assemblies, nose plates, drains, troughs, supporting frames, steel grates, etc. 4. Binwalls - concrete, steel. 5. Drainage pipes. 6. Electrical equipment. 7. Special forms - cardboard voids, sonovoids, etc. 8. Neoprene bearings when fabricator erects. 9. Paint for all exposed steel.
Stock Advance	
Inventory basis in Department warehouse. Job orders billed against inventory.	1. Guardrail, guardrail posts. 2. Piles - steel H, pipe, treated timber. 3. Hardware for timber bridges. 4. Treated and untreated timber. 5. Epoxies, abrasives, water stops, caps, caulking compounds, hot pour seal, compriband, asphaltic fibre board, burlap bags for rip rap. 6. Hi - tensile bolts, nuts, washers. 7. Neoprene bearings for contractor erected superstructures.
Inventory basis in fabricator's stockpile. Job orders billed against original requisition.	1. Reinforcing steel. 2. Standard precast concrete girder units.

The main responsibility of the Materials Engineer is to ensure that all materials required for a project are available, meet specifications, and their supply scheduled to ensure delivery for construction. To initiate ordering, the Materials Engineer prepares a requisition to the government Purchasing Department. The Purchasing Agent in turn tenders the order to suppliers by one of several methods depending on the type of material. When the supplier is chosen, inspection is set up for the particular material supplied. The inspection concerns mainly shop fabrication of the bridge materials, but may also include some field inspection when this is necessary. Generally, all inspection is done by Branch personnel under the administration of the Materials Engineer.

In order to fulfill his responsibilities under the present system, the Materials Engineer must necessarily receive appropriate information and details from both the design staff unit, the major construction staff unit and the small and standard bridges staff unit. Communication with the design unit involves the bridge plans and specifications for components of the structure supplied by the Department. Ordering of superstructure components is dependent upon completion of the superstructure drawings and the corresponding checking of the drawings and specifications. Ordering other miscellaneous materials is dependent upon completion of the integrated set of bridge drawings and the corresponding checking

of them including specifications. The Materials Engineer must be in constant communication with the design unit in order to initiate revisions on design aspects involvihg difficult fabrication techniques and on materials unavailable or difficult to supply. Communication is also necessary with the construction staff units to obtain proposed construction schedules and special provisions in order to schedule the supply of material. Setting dates seems to be the most difficult and dubious aspect of the present system of material supply since the programming does not set out these schedules in any efficient manner nor does it comprehend the program changes and their effect on this work.

The portion of the master network outlining the materials supply activities for a typical project shows the work of this unit. In actuality, the whole of the work of materials ordering involves two identical sets of activities, one for ordering the main superstructure components and one for ordering the miscellaneous materials. This is because each has a different starting event. This separation is also accountable by the variations in type of ordering.

Materials ordering may at times be a difficult phase of the operations. Scheduling of material supply may justifiably vary because of the dependencies on external factors such as construction peaks, supply of raw materials to local fabricators, methodology of fabrication and other very unpredictable occurrences. For this reason alone, a system

should be instituted which can simulate the effects of these happenings on the program when they occur, and allow management to make decisions on corrective action.

Contract Administration Unit. Activities performed during the contract administration work phase are co-ordinated and administered by the Contract Engineer. This area of responsibility includes the preparation and checking of all contract documents, liaison with other staff units of the Branch or branches of the Department, obtaining appropriate approvals where necessary, and maintaining a contract history up to the point of final project acceptance and subsequent contract release. Although much of this work spills over to and past the construction stage of a project, this paper will mainly be concerned with preconstruction activities ending in the event of contract award.

To achieve the desired objectivity of contract preparation, the Contract Engineer must necessarily bring together all details of a particular project and outline them in a manner which expresses clearly the required work as well as the responsibilities of a contractor. He is concerned with the scheduling of contract advertising, construction milestone events, and materials supply as these must be clearly integrated into the contract. For example, when construction of the approach fills is being performed by another party, stipulation

of the responsibilities of each is necessary. If a project involves external restrictions or liaison with outside authorities, such as those responsible for the Navigable Waters Act, City-Provincial Agreements, Federal-Provincial cost sharing Agreements, or the Board of Transport Commissioners Approval, the appropriate documentation and liaison must be undertaken and the restrictions clearly outlined. The procedures necessary to obtain Board of Transport Commissioners approval, or approval under the Navigable Waters Protection Act, are outlined in Appendix C. Overseeing the physical assembly and distribution of the contract specifications and documents also forms part of this work.

Once the contract is advertised and tenders received, further activities are performed which include checking of tender sheets, bid bonds, insurance, indemnity bonds, progress schedules and other documents and obtaining approval to award the contract.

Some projects that are set out on the fiscal program are tendered as a combined contract with the Construction Branch. For these contracts, some of the activities are not undertaken by the Bridge Branch, but rather by the Construction Branch. Getting the contract awarded, however, generally requires equally as much work as a separate contract.

Many structures, particularly the major bridges, will be divided into two or three separate contracts. Generally,

construction of the substructure, fabrication and erection of the superstructure and construction of the deck form the three contracts. For these projects, each contract award requires all the activities to be performed as detailed in the network diagram. This is understandingly an important aspect to consider when planning a fiscal program.

The work undertaken by the contract administration unit appears to be the most unevenly distributed in the Bridge Branch. Whether due to chance, or for some other unknown reason, it seems that at certain periods of time, this work group is heavily overloaded, while at other times there is little work to do. As the work on projects approaches this stage of completion, crash programs to get them advertised are frequently undertaken. This is not a desirable state of affairs, and is one problem which a CPM system could help alleviate. Knowing the status of each project at all stages during the fiscal program will materially aid this work group to organize its activities efficiently.

Construction Unit. All work related to the supervision of bridge construction, under contract or by Bridge Branch crews, is the responsibility of the major construction staff unit. As was clearly indicated earlier, this thesis will consider mainly the scheduling aspect of this unit's duties, as these are its only responsibilities relating to precon-

struction activities. The scheduling activities undertaken by the major construction staff unit are performed during the time the contract work is done and this phase of the work is closely interrelated, and in fact, may be considered part of the work done by the contract administration unit.

Although the work required to be done during the construction phase of a bridge project has been largely neglected, this is a fertile area in which to extend the concept of multi-project planning, and is a logical next step. As was indicated in the Introduction, this area, however, includes some very special problems not directly related to scheduling.

CHAPTER IV

PLANNING AND SCHEDULING A FISCAL PROGRAM

Planning a Fiscal Program

In Chapter I through III it has been suggested that Critical Path Techniques are favorably suited for use by highway departments as an aid to planning and scheduling. In order to illustrate the operation of a CPM system for planning and scheduling multi-project programs, a sample fiscal program was simulated. The sample fiscal program, illustrated in Appendix B, is comprised of ten realistic bridge projects that vary in size, type, and amount of investment. These projects were chosen to be as representative of an actual fiscal program as was feasible. Each project varies with respect to; the amount of work in progress, the restrictions, both external to the Department and within the Department that are prevalent, the target dates to be met, the resources necessary to carry out the project, and other information generally available at the time of program planning.

The choice of a sample fiscal program, rather than some past or future fiscal program, was made for the following reasons:

1. Use of an old program would be unjustly prejudiced with regard to the resource requirements, especially time.

2. At the time of writing, use of a new program was impossible due to the confidential nature of future projects, and because a future program was not yet in the planning stage.

3. It was felt that the use of an actual fiscal program was too large and involved for illustrative purposes and that a sample program would aptly serve, to indicate the operation and benefits of the CPM system.

The Bridge Branch fiscal planning conferences take place some months before a program is put into effect and, of necessity, must support the long range plans of the Department as a whole. The objectives for main and secondary highway development within the Province become the focal point around which any branch programs are developed. The long range highway development plans are general in nature and serve to provide guidance to the branches. Once the Branch fiscal programs are developed they are forwarded to top management of a Department for approval. Approval of a program is dependent on whether the constituent projects fit the overall plans for highway development, as well as being considerate of co-operation and co-ordination between branches. It was assumed for the sample program that these requirements have been met and that the program has been approved for subsequent planning and scheduling by the Bridge Branch.

The Planning Phase

Once the general requirements of a proposed fiscal program have been approved, the program must be planned and subsequently scheduled to make maximum use of Branch resources. When using CPM, a distinction is made between planning and scheduling, and they are treated as separate entities. A plan is defined as consisting of documentation which delineates the various tasks required to achieve a predetermined objective. The aim of the planning phase is to determine the technological sequence of any project and to outline any restrictions or obstacles that may occur. A plan is converted to a schedule when it is assigned to calendar periods or points of time in order to meet an objective date.

The planning phase of the Bridge Branch includes the following major functions:

1. Ranking each of the projects being considered for the fiscal program in its relative order of priority or urgency.

2. Analyzing all available information on each project, setting target dates, establishing a probable structure type, and outlining all restrictions including cost.

3. Recycling the planned program to top departmental levels to incorporate new decisions and actions, or to achieve consideration of deviances from the departmental objectives.

Priority ranking of projects that are considered for the fiscal program is primarily based on top management's judgement.

Generally, consideration of a large number of diverse factors is required to perform this task. The number of factors, or their nature, may not be the same from project to project and, hence, this function must be left to judgement. This thesis is not concerned with the method of priority ranking and assumes that logical consideration of all factors is accomplished. Some of the most essential factors concerning a project's priority are; main highway development, industrial development, population traffic density in the area, and the funds available for bridge construction.

Ranking the projects is essential to any system of planning and scheduling and it plays a significant role in the CPM system outlined in this thesis. In order to carry out the assignment of resources to undertake a fiscal program in an optimal manner, common sense dictates that allocation be with respect to project priorities. It must be emphasized, however, that priority ranking is only significant in those cases where a limited resource is required by two projects at the same time. It is reasonable, therefore, to assign the resource to the most urgent project first.

Setting target dates, establishing structure type, and outlining restrictions for each project are the first steps in detailing the fiscal program. Included in this function is the step of adapting the master network model to depict the work

and sequence of activities for each project. As was indicated in the previous chapter, this entails assigning zero durations to any master network activity not required, and adding those not included along with their proper sequence relationships. All of the considerations in this phase of planning are dependent on the amount of information available concerning each project, along with its relationship to the Department objectives. Under the present system of operation of the Bridge Branch, there is generally some information available on each project at the time of planning. Since many projects are internally generated it has been the practice of the Branch to compile preliminary engineering data before the project is even considered for a fiscal program. Bridge requests originating outside the department will at least have had a field investigation before being considered.

The choice of a feasible structure type for a project is based on information such as, the location and general characteristics of the project site, the experience with sites along the same stream as the project, and experience with other structures at similar locations. Aesthetic and architectural quality, and the maintenance of high standards of design and design innovation must also receive careful consideration. Choice of a structure type in this initial stage of planning seems essential because of the apparent variance in activity

durations depending on structure type. Sufficient statistics to determine the reasonableness of this assumption were not available at the time of this writing, but tests can readily be made when data becomes available.

Setting target dates and outlining all restrictions, both internal and external to the Department, requires close co-operation with other branches, with municipal authorities, and with outside agencies such as the Board of Transport Commissioners. Target dates are affected by; (1) the nature of the project, for example, if the project forms a part of a larger project such as a main hgihway route; (2) by the way the project is to be undertaken, for example, if a municipal authority or another branch is going to perform some activities on which the Bridge Branch is dependent; and (3) on the external restrictions, such as required completion dates, Board of Transport Commissioners approval, and the supply of materials. Probably the most important restriction on any fiscal program is the availability of funds, so this is of paramount importance at this stage of planning. To estimate the cost of a project at this stage in the program development, requires that planning be done to the level of detail indicated above.

<u>The Scheduling Phase</u>

Scheduling may be defined as the translation of a plan

into a timetable with specific calendar dates, which will govern the start and completion of work and authorize the expenditure of resources on each activity in the plan. Once the details of the planning phase have been established and agreed upon, the scheduling phase can be undertaken within the boundaries set by the restrictions. A major constraint in scheduling is the requirement to conform to the plan. The steps undertaken to accomplish the scheduling function are as follows:

1. The resources of manpower, equipment, and money available to the branch should be tabulated.
2. For each activity of each project, the skills required and the time necessary to accomplish it should be determined.
3. Time estimates for activities need to be converted into specific calendar dates for starting and completing the work.

Manpower resources can be tabulated according to the skills or capabilities of the individuals comprising each organizational unit of the Branch. The categorization of manpower skills used in this thesis was simply related to the work performed by each individual, however, such classification of skills can be much more sophisticated. The degree of sophistication depends largely on how detailed the work can be subdivided into specific activities, requiring specific abilities for their performance. For example, design engineers

can, and probably should, be further classified according to experience and level of ability. Senior design engineers capable of handling the most difficult of projects could be regarded separately from junior design engineers who would be assigned the simpler projects. Sub-classification becomes important for fiscal programs comprised of projects of widely varying design complexity, if resource time is to be used efficiently.

Assignment of normal duration times for each activity of a project is not a simple procedure. This aspect of scheduling must be considered a prime function, because the entire worth of a planned program depends on the quality of the time estimates. The estimated time required to perform each activity in the network is based on the planned manpower or other resources assigned to the activity and the average resource application rates or work schedules. For example, it makes a significant difference whether resources are applied for a forty-hour week rather than a forty-four hour week, or whether two shifts are used. Time values should initially be considered as flow time and not in terms of calendar dates.

Time estimates should be made by personnel most familiar with individual activities. The quality of the time estimates will depend on their background and understanding of the work to be performed. It was indicated in Chapter III that a

desired policy was to have one design engineer perform all the design activities for a particular project. In estimating times for these activities, a workable method would be to have a design engineer and the Chief Design Engineer sit down and consider the work involved along with performance requirements.

Time estimates may be in any desirable units. Weeks, months, days, or fractions of these units are commonly used, but the choice depends on the nature of the project. It was felt that, for this type of work, and considering the degree of refinement of the activities desired, days were the most meaningful units to use.

Once time estimates have been assigned to all the activities of a project, the next step is to convert these into specific calendar dates. The method of accomplishing this step is routine and will not be dealt with in detail. This step involves consideration of the normal work week, policies governing work practices, holidays, and any other local policy regarding the dates available to perform work on. For the sample fiscal program undertaken in this study, a computer program was used to perform a large portion of this work. Computer input data and computer output formats for one project of the sample program are shown in Appendix B. Actual dating was performed manually. However, this aspect could just as well have been programmed for the computer to handle. Explanation of the computer results is given in Appendix B.

The dating procedure to derive scheduled dates for every activity was performed using the target dates established in the planning phase as starting points. As a project may have more than one target date specified, it must be made explicitly clear during the planning phase which date is most critical, since the schedule will be keyed to it. In the sample fiscal program undertaken, the contract award target date, or the final completion date was felt to be the most desirable starting point for scheduling the projects.

As may be noted thus far, planning and scheduling have been treated as separate and discrete functions. However, the interdependence between the two must be maintained and the logical relations should not be disturbed. The schedule must validate the plan by converting it to a feasible timetable. If the schedule cannot validate the plan for any reason, appropriate changes must be made to the plan. Thus, once scheduled dates have been assigned to each activity on the network, all target dates should be scrutinized to determine if they are realistic or feasible. If, for example, a particular event was directed to be completed by a target date set out in the plan, and this was not possible to achieve according to the schedule, a decision must be made as to what course of action to take. The target date can be adjusted, necessitating a review of the plan, or certain activities in

the project can be shortened by adding more resources or increasing the length of the work day in order to meet the target date, or the total project can be shifted in time so that the target date is met. Recycling to incorporate new decisions and actions is also an integral part of the scheduling function.

Resource Levelling. Resource levelling is another informative aspect of the CPM system proposed, and logically follows the scheduling phase. Since the computer program used for this thesis did not have the capability of performing this part of the work, manual calculations were undertaken to provide the resource charts shown in Appendix B. Given the approved schedule for the ten projects in terms of calendar dates, along with the assignment of skills required to accomplish each activity, it is possible to determine the manpower requirements for each period throughout the fiscal program. Each skill can be analyzed in this manner, and may be displayed on a bar chart to illustrate the variances in work loads. The resource usage charts shown in Appendix B assumed that all activities would be started at the earliest possible time and show the peaks and slack periods accordingly.

Subsequent analysis of resource requirements makes use of the concept of float, which indicates the latitude of time within which individual activities or paths may start and

finish. By proper use of the various categories of float, it may be possible to level manpower peaks and to shift resource usage to obtain a more desirable and steady workload for all skills throughout the fiscal period. The explanation in Appendix B illustrates this point. If it is not possible to achieve the desired degree of resource levelling by making use of available float, the alternative exists to recycle back to the plan and make adjustments in the target dates or other restrictions. The adjustments made to the plan to achieve even workloads and optimum usage of limited resources, depends largely upon the judgement of the top management of the Branch. The benfit of using a CPM system is that alternative courses of action to achieve this purpose may be projected to determine the effects on other parts of the program, in terms of the total framework of the program.

Reporting and Control

Most of the work function that has been discussed thus far has been limited to one Branch level. The planning and scheduling phases are completed once a program has been developed to make optimum use of limited resources, meeting directed dates, and achieving co-ordination with parties external to the Bridge Branch. During the planning and scheduling process, adjustments in target dates and restrictions on projects may have necessitated recycling and review at the

top departmental levels, a point not explicitly outlined in the preceeding paragraphs. It is assumed hereafter, that when such an occasion arises, that this is accomplished. Thus, once a program is approved to get underway, it may be considered as a best solution given the circumstances prevailing.

As a fiscal program, or any project for that matter, proceeds frequent changes, revisions, deletions and additions become evident, and the program must be updated accordingly. The reasons for periodic updating of a program as it is being carried out may result due to changes in the objectives, changes in the plans to achieve the objectives, schedule slippages or gains in activity durations, or changes in the resources available for its undertaking. In the case of a fiscal program for a highway department, changes may be a result of project deletions or additions, the need for recycling certain activities, or delays in the supply of materials. For example, if during the foundation investigation for a particular project it was found that the planned type of structure was no longer feasible, a revision of the remainder of the project would have to be undertaken and the schedule updated. A decision is required as to what course of action should be taken so as not to disrupt the remainder of the program and still achieve the desired objectives. With a totally planned system it is possible to project what influences alternative courses of action have on

the total program. The effects of such an occurrence may upset the total resource usage schedule of the design work group, or it may happen during a period when the design load is at a minimum and the problem can be easily alleviated. It may require that certain activities of another project need to be shifted in time to allow this project to continue, or it may require that the project be totally rescheduled to another time period altogether. Only by the use of a system as is proposed, can such pertinent questions be answered and used as a basis for decision making. While uncertainty is by no means overcome, decisions can be based on an overall picture and on reasonable and logical projections.

Regular progress reporting and evaluation of progress is a prime function of any system of planning. The main purpose of this function is to correlate actual results to the plan. The plan serves as a guide to evaluate progress and to admit adoption of management-by-exception. Only on those occasions when the progress deviates significantly from the plan is there any action taken to correct the situation. If such a system is to function effectively, sound and careful planning is essential.

The program evaluation process is the means by which management can be assured that all work groups are making intelligent use of resources, priorities, and delegated

authority; that the work flow is integrated and co-ordinated; and that all participants are working toward a common goal. frequency of progress reporting depends largely on the level of responsibility, the degree of detail in the report, and the status of the program. Program rescheduling, however, should be a flexible undertaking and be done only when the need arises, for example, when a major revision in the program occurs, or when the progress reports indicate significant deviation from the plan. It must be emphasized that to a large degree, rescheduling may be done using manual methods. An excellent treatment of manual methods for this purpose has been advanced by Professor John Fondahl.[1]

Progress reporting and evaluation is basically an upward flow of selective data through the hierarchy of management. Its use is for guiding the efforts of those responsible for specific program elements. As such, the determination of information requirements for each level of management must be based on their specific needs. Generally, managers at any level want only that information which concerns their activities and responsibilities. This information must be in understandable form and easy to use, with quality rather than quantity being stressed. Top management is not concerned

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[1]John W. Fondahl, Methods for Extending the Range of Non-Computer Critical Path Applications. (Stanford: Department of Civil Engineering, 1964).

with whether the general layout drawing is two days behind schedule, but rather, would like to know the status of each project in relation to the plan.

The information system must provide answers to the following kinds of questions for a specific area or for the program as a whole: (1) Is the actual performance meeting planned performance in terms of schedule, cost and resources, and if not, why not?, (2) What is the outlook for meeting future performance and schedule commitments?, and (3) What major factors are controlling time and cost requirements? Above all, the progress reports must be timely. An indication of an approaching problem today is infinitely more valuable than a detailed blueprint of the situation weeks later.

The determination of information requirements is partly a matter of taste on the part of management personnel. For this reason, and because a detailed analysis of report formats, reporting frequencies, and data summarization techniques is beyond the scope of the thesis, this topic will not be dealt with in further detail. To undertake such a study would require investigation into the paper flow and formats presently existing within the Bridge Branch, and revising or replacing them with a desired system. Outlining an information system is, however, actually part of the implementation phase of the overall CPM system.

Implementation and Education of Personnel

While it is not intended in this thesis to outline a detailed procedure for the implementation and operation of a CPM system, certain principles and consideration for implementation should be pointed out at this time. By far the most important and significant step in the establishment of a CPM system, is the endorsement of it by top level management. Unless the use and benefits of such a system are officially acknowledged, and the technique authorized at this level, little except dissappointment and disillusionment can be attained. Along with the authorization, specific objectives concerning the scope, desired results, and timing must be outlined.

Effective implementation can only be accomplished in an orderly manner, with due consideration given to the procedures for the operation of the system, and the compatibility with the requirements of operating personnel. The functional operation of a CPM system should be the responsibility of the normal supervisory staff and management personnel. Specific or special functions may be assigned to an operating group. Because it is the operative and supervisory personnel who provide most of the data to the system and who must make use of the information derived from it, these people must acquire the skills for its effective operation. One of the most difficult hurdles in implementing a new system is to get the people involved to

depart from the old way of doing things and to accept a new method. The problem is not usually that of total resistance but reluctance to part with conventional systems. The procedure for effective implementation must then be structured so as to convince people that the new is as good as or better than the old. Indoctrination and training of personnel cannot be overstressed as a prime factor, if any such new system is to be successful.

As was noted earlier, the implementation phase includes the function of specifying report formats, frequency of reporting, distribution of the reports and the procedures for integrating a proper information system. Although computers are available to assist in processing large quantities of data, the computer is secondary to the establishment of procedures.

It cannot be emphasized strongly enough that the success of a CPM system depends largely on its proper implementation. Lack of implementation planning is the number one reason for the failure of this management tool. The success of a system is directly proportional to the effort and planning necessary for its accomplishment.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

General Conclusions

It has been the objective of this thesis to illustrate a CPM system of planning and scheduling a highway department fiscal program. The purposes of such a system are to; (1) aid highway management to keep the supervision of increasingly complex operations within the scope of human capability, (2) to provide all levels of management with meaningful and up-to-date information as a basis for judgements and decision making, and (3) insure efficient, economic utilization of the resources at its disposal. The system proposed, which is based on Critical Path Techniques, accomplishes these aims.

The ultimate objective of the Alberta Department of Highways is to provide the most convenient, economical, and safe transportation system in the shortest time possible with the available funds. Both the short-range and long-range planning of the Department must be consistent with the economic, population, and traffic growth in the Province. At the present rate of highway expansion in Alberta, orderly selection of projects making up the fiscal programs is necessary, and a need is developing for a system which provides effective control over time and, its basically essential companion, manpower.

Highway programs differ from other large construction projects in the respect that the total program is comprised of a large number of complex, and individual projects. If the best use of time, money, and manpower is to be secured, an integrated system for planning, scheduling, and control of fiscal programs is required. The old, familiar bar chart, which has seen extensive use in the past, cannot depict the detail necessary for the proper managerial control of a multi-project program. A total Management Information System must fulfill the following objectives:

1. Define the total program in dollars, physical projects, and functional tasks.
2. Link long-range planning and functional management.
3. Predict likely problem areas before they occur.
4. Illustrate the effects of planning changes.
5. Establish performance targets for each organizational unit.
6. Provide yardsticks for measuring performance.
7. Simulate the effects of program changes and slippage related to new policies or changes in data.
8. Provide a common means of communication both within and outside the Department.

A number of modern techniques which employ the network approach of organization of work do attain these objectives, and could be applied in highway management. The choice of the Critical Path Method was arbitrary, but was felt to best serve

the objectives of the Department. The system discussed and illustrated in this thesis should more properly be termed the Critical Path Technique in recognition of the fact that procedures of other network methods are also employed.

The CPM system for multi-project programming is an effective tool and of considerable aid to efficient highway management. It provides an easy and orderly method of planning, scheduling, and control. Additionally it provides for flexibility and the ability to project the effects of changes, thereby helping top management to secure a more complete picture of operations. While the system developed in the thesis is based on the operations of the Bridge Branch of the Alberta Department of Highways, the basic concepts apply equally well at the departmental level, or for other branches within the Department.

The implementation of a CPM system is not without problems, however, and the success of the system is dependent on the manner in which these are solved. The two major aspects of effective implementation are; (1) the indoctrination and training of personnel, and (2) the planning of information flows and information requirements.

While it has been concluded that a CPM system is a highly efficient method and is adaptable to the Alberta Department of Highways operations, it must be stressed that it is not a

panacea for poor management. It must be clearly understood that this is only a tool, and as such cannot automatically make management decisions. To introduce such a tool for the purposes outlined, requires top management's approval, and such approval is not likely to be obtained until a definite need for the improvement of present procedures is felt. Change, simply for the sake of change is a poor criterion on which to undertake any proposal.

Recommendations for Further Study

As is fairly obvious, a number of aspects of a total Management Information System have been circumscribed completely, or have not been dealt with in any detail. These areas provide the avenues for further study. The following are the areas in which further study and analysis would prove fruitful, and complementary to the work undertaken in this thesis:

1. Outline the objectives, desired results, and timing considerations for a departmental system, and devise the procedures for its operation.

2. Study the present information system of the Department and its branches in terms of flow, information requirements, and reporting systems.

3. Study the maintenance operations and construction operations of the Bridge Branch and implement these into the CPM system if so desired.

4. Consider the development of a data bank for the storage of time, cost, and manpower details associated with particular activities. After a period of time, statistical analysis can be made on this information to determine the degree of variation and its causes.

Considerable thought must be put into defining the procedures for a CPM system. In the areas of activity performance and time duration estimates, this is particularly critical. Complications will arise because there may be several ways of answering a question, eg. how a certain activity is to be performed? It may be any of the following:

1. The way the supervisor thinks it is done.
2. The way the employee thinks the supervisor wants it done.
3. The way the supervisor tells the employee to do it.
4. The way the instruction manual says it should be done.
5. The way it is actually done.

It is not here proposed that thick manuals be written outlining in fine detail how every entry should be coded or analyzed. Rather, the purpose should be to outline the general concepts which will, in turn, establish the trends for training personnel. Because indoctrination and training of personnel plays a major role in the proper implementation of a CPM system, establishing how this may be accomplished, without disrupting the normal work of the Department, is a study in itself.

The timing of, and methods used to implement a CPM system, can be undertaken in several ways. It can be done in one step by providing an overall departmental system, or it can be done by instituting sub-systems, such as that proposed for the Bridge Branch, eventually reaching a total departmental system. The choice depends on the top management's evaluation as to how critical the need for change is, and the problems involved in implementation.

This thesis is but a preliminary step in solving a growing problem of highway management. It is realized that similar work has been done in other areas and in other highway departments. However, like any process or system the Critical Path Method must be adapted to meet the needs of each individual organization. This adaptation and the co-operation of all the management personnel of the organization is a prerequisite to its successful use. It is felt that the basis for accomplishing these ends is provided for by this study.

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APPENDIX A

CPM ACTIVITY DESCRIPTIONS

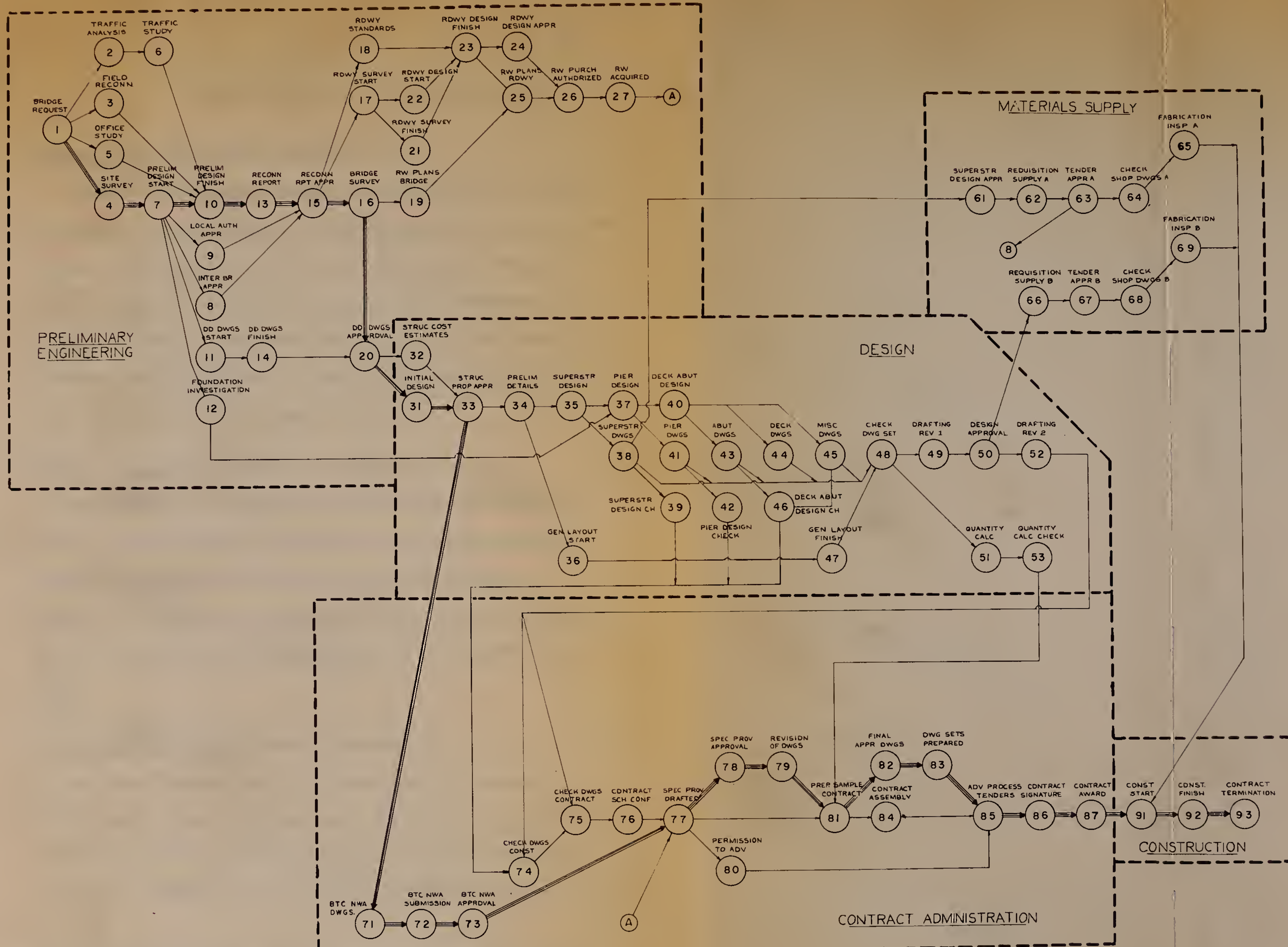


FIGURE 5. MASTER NETWORK DIAGRAM FOR PRECONSTRUCTION ACTIVITIES, BRIDGE BRANCH, ALBERTA DEPARTMENT OF HIGHWAYS.

MASTER NETWORK
for
PRECONSTRUCTION ACTIVITIES
BRIDGE BRANCH
ALBERTA DEPARTMENT of HIGHWAYS
Project GCG-21 critical path shown

Activity Number	Activity Title and Description
1	Bridge Request (Bridge Request)[1]

Review of a formal request for a structure from any source, with regard to the scope of the undertaking in general terms and the necessary steps to obtain approval to begin study on it. Approval to begin preliminary engineering may be in the form of a signed authorization, a letter, or verbal notification from the Chief Bridge Engineer.

2 Traffic Analysis (Traffic Analysis)

Assignment of department personnel or contract of an outside agency to perform a detailed traffic analysis which may include origin-destination surveys. Outline of traffic volumes, peak volumes, centers of gravity, and preparation of charts and plans.

3 Field Reconnaissance (Field Reconn)

On site inspection or inspections to obtain preliminary information on such factors as type of terrain, river characteristics, land development and access, runoff and hydraulic characteristics,

[1] The title in brackets indicates the shortened form of the activity title necessary for computer processing, using the earlier noted computer program.

Activity Number	Activity Title and Description
	alternate routes, present road system, traffic patterns, and special details concerning foundations, river diversions or other factors.
4	<u>Site Survey</u> (Site Survey) Preliminary survey of the site to obtain vertical and horizontal control of the terrain, cross sections through the bridge site, establishment of marks and lines for future surveying, details of river width and depth and tying in other relevant details necessary for preliminary design. Preparation of profiles, plans and drawings outlining the survey information. This activity would include the work necessary to obtain this information on any number of alternate locations when this is the case.
5	<u>Office Study</u> (Office Study) Compilation of historical information on the site from files and prior inspections, initial study of aerial photography concerning land and river features, roads and access, possible alternate locations and general details to be verified by field reconnaissance or site survey. Determination of river flow characteristics.

Activity Number	Activity Title and Description

6 <u>Traffic Study</u> (Traffic Study)

Review of the information provided by the traffic analysis and the preparation of recommended standards and details based on these data. The standards and details will be reviewed again during subsequent work activities.

7 <u>Preliminary Design-Start</u> (Prelim Design Start)

Integration of information compiled by the site survey, field reconnaissance, office study and traffic analysis activities. Review and preliminary calculations regarding grades, horizontal alignment, height and length of structure and standards.

8 <u>Department Inter-Branch Approval</u> (Inter Branch Appr)

Review of preliminary drawings and data by other branches of the Highway Department when the project necessitates the co-operative efforts of these branches.

9 <u>Local Authority Approval</u> (Local Authority Appr)

Review of preliminary drawings and data by the municipal, county, city or other local authorities in whose jurisdiction the project is proposed.

Activity Number	Activity Title and Description
	Presentation of recommendations and general approval by these authorities.
10	Preliminary Design - Finish (Prelim Design Finish) Evaluation of alternative locations with respect to gradelines, structure requirements, grading, river training works and other items necessary to have an operational facility. Preparation of semi-complete drawings showing chosen data and supporting calculations.
11	Preparation of Design Data Drawings - Start (DD Dwgs Start) Initial preparation of drawings incorporating all data from preliminary engineering and design required for structural design. Preparation of drawings and plans showing pertinent details for further consideration of alternative locations.
12	Foundation Investigation (Foundation Invest) Drilling and/or soils investigation of the proposed site to obtain relevant information regarding soil types, moisture conditions, bearing capacity and other data necessary for foundation design.

Activity Number	Activity Title and Description
13	<u>Reconnaissance Report</u> (Reconn Report) Preparation of a preliminary engineering report outlining the conclusions and recommendations based on the preliminary investigation. The report includes the evaluation of alternative routes, alternative structures, relevant cost estimates and other supporting data necessary for higher level approval.
14	<u>Preparation of Design Data Drawings - Finish</u> (DD Dwgs Finish) Preparation of final design data drawings including the necessary data and information required to design the structure. Included is the review of the drawings and all necessary subsequent revisions.
15	<u>Reconnaissance Report Approval</u> (Reconn Report Appr) Review and appraisal of the reconnaissance report by higher level management. Economic evaluation, priority level and recommendations prepared. Authorization to continue work on the project.
16	<u>Bridge Survey</u> (Bridge Survey) Completion of any further surveying or other data gathering necessary to complete the design data drawing and its subsequent review.

Activity Number	Activity Title and Description

17 <u>Roadway Survey - Start</u> (Rdwy Survey Start)

Preliminary survey of the roadway alignment and approaches to a bridge structure. The activity includes all survey work necessary to begin roadway design, which entails data and drawings of cross-sections, drainage, horizontal and vertical control and setting control marks for subsequent construction surveying. All or a portion of this activity may be performed by the Construction Branch rather than the Bridge Branch depending on whether the structure is on a main district or local road.

18 <u>Roadway Standards Decided</u> (Rdwy Standards)

Standards of the roadway alignment and bridge structure are set out if this has not been decided by higher level management. This activity is not required except in special cases as general standards are usually followed.

19 <u>Right-of-Way Plans - Bridge Structure</u> (RW Plans Bridge)

Preparation of plans showing the required right-of-way for the bridge project.

Activity Number	Activity Title and Description

20 Design Data Drawings - Approval (DD Dwgs Approval)

Review of completed design data drawings and supporting data and outlining revisions and recommendations regarding the project. This activity includes the time necessary to correct the drawings and data if any revisions are necessary.

21 Roadway Survey - Finish (Rdwy Survey Finish)

Completion of all survey work necessary to finalize the roadway and approach road design.

22 Roadway Design - Start (Rdwy Design Start)

Preliminary roadway and approach road design including setting trial gradelines, calculating earth quantities, designing drainage facilities and outlining other special features. This activity is generally carried out in conjunction with the roadway survey.

23 Roadway Design - Finish (Rdwy Design Finish)

This activity is a continuance of the preliminary roadway and approach road design. Choice of an optimum gradeline, completion of drainage design, computation of all relevant quantities and preparation of suitable drawings necessary for subsequent construction.

Activity Number	Activity Title and Description
24	Roadway Design Approval (Rdwy Design Appr)

24 Roadway Design Approval (Rdwy Design Appr)

Review and appraisal of the approach road design by higher level management. Under the present system, approach road design is undertaken by the Construction Branch and approval is indicated by the Bridge Branch since the costs of both design and construction are borne by the Bridge Branch.

25 Right-of-Way Plans - Roadway (RW Plans Rdwy)

Preparation of plans showing the required right-of-ways for the approach roads.

26 Right-of-Way Purchase Authorized (RW Purch Authorized)

Approval and authorization by higher level management for either the surveys branch or the local authorities to purchase the right-of-way as detailed.

27 Right-of-Way Acquired (RW Acquired)

Certification that the right-of-way for the project has been acquired. This activity is highly simplified for this model and may be subdivided into more detailed activities.

31 Initial Design (Initial Design)

Review of the design data of the project with

Activity Number	Activity Title and Description
	respect to such considerations as feasible structure types, clearance, span lengths, aesthetic qualities and other special details.
32	Alternate Structure Cost Estimates (Struc Cost Estimates)
	Preparation of cost estimates on all alternate structure types considered feasible.
33	Structure Proposal Approval (Struc Proposal Appr)
	Review of the initial design recommendations and cost estimates and authorization of the design of a particular structure or a number of alternate structues.
34	Preliminary Details (Prelim Details)
	Calculation of geometric details of the project. Decision on loadings and consideration of any other preliminary details necessary to begin a detailed structural design.
35	Superstructure Design (Superstr Design)
	Perform a detailed structural analysis to define the superstructure components of the structure.

Activity Number	Activity Title and Description

36 <u>General Layout - Start</u> (General Layout Start)

Start drafting the general layout drawing following the guidelines indicated by the design data sheet. Show the restrictions determined by the preliminary engineering and the general details ascertained up to this point.

37 <u>Pier Design</u> (Pier Design)

Perform a detailed structural and stability analysis of the piers and foundations.

38 <u>Superstructure Drawings</u> (Superstr Dwgs)

Prepare detailed drawings of the superstructure components showing all pertinent details necessary for their fabrication or construction.

39 <u>Superstructure Design Check</u> (Superstr Design Ch)

Perform an independent design analysis to confirm that critical portions of the initial superstructure design are adequate according to specifications.

40 <u>Deck, Abutment and Miscellaneous Design</u> (Deck Abut Design)

Perform a detailed structural analysis of the deck and abutment components of the structure. Outline the details of miscellaneous items such as

Activity Number	Activity Title and Description
	expansion assemblies, drains, bandrail, pier nose plates, etc.
41	Pier Drawings (Pier Dwgs) Prepare detailed drawings of the piers and foundations showing all pertinent details for subsequent fabrication or construction.
42	Pier Design Check (Pier Design Check) Perform an independent structural and stability analysis of the piers and foundations to assure they are capable of supporting the structure.
43	Abutment Drawings (Abut Dwgs) Prepare detailed drawings of the abutment components showing all pertinent details for subsequent construction.
44	Deck Drawings (Deck Dwgs) Prepare detailed drawings of the deck showing all pertinent details for subsequent construction.
45	Miscellaneous Details Drawings (Misc Dwgs) Prepare detailed drawings of all miscellaneous items showing all pertinent details for subsequent fabrication or construction.

Activity Number	Activity Title and Description
46	<u>Deck, Abutment and Miscellaneous Design Deck</u> (Deck Abut Design Ch) Perform an independent structural analysis of the deck and abutment components to assure they are adequate. Check all miscellaneous details to assure they are functional.
47	<u>General Layout - Finish</u> (General Layout Fin) Complete the preparation of the general layout drawing to show the scope of the project as a whole.
48	<u>Integration and Check of Drawing Set</u> (Check Dwg Set) Check the complete set of structural drawings for consistency to assure components will fit, that specifications are consistent and to correct drafting errors.
49	<u>Drafting Revision 1</u> (Drafting Rev 1) Correct the set of structural drawings as indicated by the designer.
50	<u>Design Approval</u> (Design Approval) Performance of a general over-all check of the structural drawings by the Chief Design Engineer to ensure compliance with standards and specifications, as well as for special details concerning the project.

Activity Number	Activity Title and Description
51	Quantity Calculation (Quantity Calc) Calculate quantities of materials and work items necessary to construct the bridge as detailed. These will form the bid items which will appear on the tender sheet.
52	Drafting Revision 2 (Drafting Rev 2) Perform any further drafting revisions of the structural drawings before they are presented for higher level management approval.
53	Quantity Calculation Check (Quantity Calc Check) Perform an independent check of all quantities of material or work necessary to construct the bridge.
61	Superstructure Design Approval (Superstr Design Appr) Obtain approval and authorization to requisition fabrication of the superstructure components.
62	Requisition for Supply A (Requisition Supply A) Prepare requisition document for the supply of superstructure components. Check drawings and specifications and schedule supply dates to be consistent with the proposed construction schedule.

Activity Number	Activity Title and Description

63 <u>Tender Approval A</u> (Tender Appr A)

Check all tenders submitted for the supply of the superstructure components including bonds and insurance. This activity includes the time the requisition is held by the Purchasing Department.

64 <u>Check Shop Drawings A</u> (Check Shop Dwgs A)

Check shop drawings for the fabrication of the superstructure components for accuracy. This activity includes the time for the preparation of the drawings by the supplier.

65 <u>Fabrication Inspection A</u> (Fabrication Insp A)

Inspection of fabrication procedures and assembled components to ensure that specifications are being met.

66 <u>Requisition for Supply B</u> (Requisition Supply B

Prepare requisition document for the supply of all materials provided by the Bridge Branch such as handrail, bearing pads, paint, etc. Check drawings and specifications and schedule supply dates to be consistent with a proposed construction schedule.

67 <u>Tender Approval B</u> (Tender Appr B)

Check all tenders submitted for the supply of

Activity Number	Activity Title and Description
	requisitioned materials. This activity includes the time the requisition is held by the purchasing department.
68	Check Shop Drawings B (Check Shop Dwgs B) Check shop drawings of any items being fabricated for accuracy. This activity includes the time for preparation of the drawings by the supplier.
69	Fabrication Inspection B (Fabrication Insp B) Inspection of fabrication procedures and assembled components to ensure that specifications are being met.
71	B.T.C. or N.W.A. Drawings[1] (BTC NWA Dwgs) Prepare drawings of the proposed project according to the standards set out by Board of Transport Commissioners or the Navigational Waters Act when the project comes under their jurisdiction.
72	B.T.C. or N.W.A. Submission (BTC NWA Submission) Prepare the submission to the Board of Transport Commissioners or the Navigational Waters Act according to the regulations set out.

[1] See Appendix C for an outline of the regulations pertaining to the Board of Transport Commissioners Submissions and the Navigational Waters Protection Act.

Activity Number	Activity Title and Description

73 <u>B.T.C. or N.W.A. Approval</u> (BTC NWA Approval)

This activity includes the time taken either by the Board of Transport Commissioners or the body concerned with the Navigational Waters Act to check the submission and drawings, consider submissions by affected parties, inspect the site, and provide certification to proceed with the project.

74 <u>Check Drawings - Construction Details</u> (Check Dwgs Const)

Check the working drawings for the project from a construction point of view. Outline the construction schedule indicating completion dates for milestone events which is in co-ordination with the material delivery schedule.

75 <u>Check Drawings - Contract Details</u> (Check Dwgs Contract)

Check the working drawings for clarity and completeness in showing the work required. Outline the contract schedule dates for advertising, tender call and award.

76 <u>Contract Scheduling Conference</u> (Contract Sch Conf)

Check all construction schedule, contract schedule, and material delivery schedule dates to

Activity Number	Activity Title and Description

to assure that the desired co-ordination is achieved.

77 <u>Special Provisions Drafted</u> (Spec Prov Drafted)

Prepare a draft of all information required to clearly outline the work and the responsibility of the contract not covered by the standard specifications. This would include such details as provisions for traffic through the project or special detail specifications.

78 <u>Special Provisions Approval</u> (Spec Prov Approval)

Review and appraisal of the special provisions, project schedule and contract drawings by higher level management.

79 <u>Revision of Drawings and Special Provisions</u> (Revision of Dwgs)

Perform any revisions of the contract drawings and special provisions indicated.

80 <u>Permission to Advertise</u> (Permission to Adv)

Prepare advertising format for the pertinent media and obtain approval to advertise the project for tenders.

Activity Number	Activity Title and Description
81	Prepare Sample Contract (Prep Sample Contract) Prepare a sample contract including all specifications, documents and plans which pertain to the project.
82	Final Approval of Drawings (Final Approval Dwgs) Review of contract and drawings by the Chief Bridge Engineer and certification of the project by his signature on the drawing set.
83	Drawing Sets Prepared (Dwg Sets Prepared) Prepare the required number of drawing sets for contract tender.
84	Contract Assembly (Contract Assembly) Assemble the required number of contract specifications and documents and check to ensure that all are correct and ready for distribution.
85	Advertise and Process Tenders (Adv Process Tenders) Distribute the contract for tenders. Check the tender submissions, prepare a letter of acceptance to the chosen contractor and prepare the documents to be signed by the contractor such as a progress schedule, insurance endorsement, copy of the Public Works Act and an indemnity bond.

Activity Number	Activity Title and Description
86	<u>Contractors Signature and Approval</u> (Contract Signature) Endorsement of the proper documents by the contractor and subsequent approval by the department that such documents are in order.
87	<u>Contract Award</u> (Contract Award) Obtain the Minister of Highways signature on the contract and authorization to begin construction. Notification to contractor to begin work on the project.
91	<u>Construction Start</u> (Construction Start) Completion of the first major stages of construction. This activity represents the first stages of a network of construction activities.
92	<u>Construction Finish</u> (Construction Finish) Completion of the work specified for the project. This activity represents the remaining stages of a network of construction activities up to final approval of the project.
93	<u>Contract Termination</u> (Contract Termination) Inspection of the project by Bridge Branch personnel and final approval of all work performed. Preparation of detailed final estimates and contract release documents.

APPENDIX B

SAMPLE FISCAL PROGRAM

The descriptions of the ten projects comprising the sample fiscal program are outlined below. The purpose of the sample program is to illustrate the operation of the CPM system outlined in the text of the thesis, to indicate the types of information available, and the uses to which they may be put.

SAMPLE FISCAL PROGRAM

File Code	Description
GD 355 Priority 1 (SP2011)	This structure is one project on the proposed upgrading of a main highway route from a two-lane facility to four lanes. The structure will be designed as a twin to the existing structure on the existing roadway. Preliminary survey and main highway design are underway with gradeline, roadway, bridge site survey, and other pertinent information required for the structure design available from the Construction Branch. At this time Bridge Branch preliminary engineering on the structure is complete to the preliminary design start stage. No independent traffic analysis is required. Completion of the bridge is to be tentatively scheduled as October 15 to phase in with the main highway construction schedule. Estimated construction time required based on preliminary engineering information to date is eight months. The structure will be precast with type 0 girders and poured in place concrete deck.
GD 596 2 (TH1002)	This structure is an overpass with the main highway travelling under. It is on the same route as the above structure but differs in that no existing structure exists over the main highway at present. Profiles and data necessary for the design of the structure are to be provided by the Construction Branch by March 1. Construction of the bridge is closely tied in with main highway construction. Approach fills and main highway grade to be complete

File Code	Description
	before structure construction, and structure to be near complete before base course and paving to be started in this area. Tentative completion date to be scheduled as September 15.
GF 081 3 (SP1002)	This project forms a part of a complete new main highway route through virgin land. Main highway preliminary survey and design is well advanced on this part of the route. Bridge Branch preliminary engineering is completed to site survey with field reconnaissance complete and only a minor part of office study accomplished. The anticipated bridge type is steel with rolled girder sections and composite deck, based on the preliminary engineering to date. Scheduling is a major importance for this route as construction provides access to further portions of the work. For this reason tentative completion date is September 30, and bridge construction is dependent on the placement of headslopes by the main highway contractor by a date to be scheduled around June 1. Anticipated construction time required for a bridge of this size is four months.
GD 599 4 (TH2015)	This structure is part of the proposed route on which projects 1 and 2 are a part of. The structure will take all four lanes of the highway, two existing and two being constructed over a district highway. As such, part of the existing lanes will be reconstructed to provide the necessary vertical alignment for the structure construction. It is proposed that the traffic will be routed around the location during construction. Tentative completion of the overpass is August 31, to allow base course and paving to be completed by winter. Profiles and other datum required for design is to be supplied from Main Highways Branch by March 1. The anticipated bridge type at this location is precast type HC girders with paved roadway.
GD 353 5 (SP2019)	This project is of a more major type with winter construction of the substructure desirable. At this time low water is prevalent, ice provides a natural workbridge and construction time for the

File Code	Description
	structure is too long for schedule completion before winter. This bridge is part of the main highway route upgrading program with two additional divided lanes being constructed alongside existing lanes. The structure will be a twin to the existing structure with minor design modifications as required. The existing bridge is a cast in place concrete T girder type. Field reconnaissance, site survey and office study are all near completion, and further preliminary engineering is required for the design of river training works. Proposed contract advertising date is September 1.
GF 102 6 (TH2015)	This project is part of a main highway route upgrading program. The existing roadway is being widened and reconstructed with some revision in alignment to attain superior standards. The structure will carry main highway traffic over the main street of a town to alleviate the intersection problems of the existing facility. Profiles and other data required for design are to be supplied by Main Highway Branch by April 1. The anticipated bridge type are precast type M girders with paved roadway. It is desirable to have the structure completed by September 30 to allow co-ordinated paving of both highway and bridge.
GE 529 7 (SP2011)	This structure is part of a main highway relocation. Preliminary survey and design by the Construction Branch is well advanced and Bridge Branch preliminary engineering of the site is complete to the preliminary design start event. It is hoped that the structure will be completed by October 1, to allow traffic to use the new section of highway. Based on the preliminary engineering information to date the anticipated structure type will be precast type 0 girders with cast in place concrete deck.
AC 5 8 (SP2011)	This project is necessary to replace an old low standard bridge with a high standard facility, capable of handling present and anticipated future traffic volumes adequately. At this time the

File Code	Description
	reconnaissance report outlining preliminary engineering recommendations is complete. It is probable that a precast type 0 girder with a cast in place deck will be the most economical at this site. Traffic may use the existing bridge until completion of the new structure. As such, it is desired to have the contract awarded by August 30, to allow winter construction of the substructure. The deck will be placed during the next fiscal period. The Branch will as well proceed to construct high standard approach roads to the new structure. Because this crossing is on a major river, an application must be made according to the Navigable Waters Protection Act.
AK 74 9 (SP1005)	This project forms part of a main highway upgrading program. The existing two lane bridge is to be widened to become a four lane structure. A complex interchange system is to be provided to carry traffic efficiently across the structure and provide access to intersecting roads. Because of the terrain, river training works must be designed to allow construction of the proposed intersections and secondary roads. At the time of scheduling field reconnaissance and site survey have been completed with a small portion of office study done. The structure will be a steel welded girder with concrete poured in place deck to match the existing structure. Design will be a minimum, but an excessive amount of detail is involved in adding extra width to an existing bridge. It is desired to have the contract advertised by August 22, to allow winter construction of the substructure. This project involves co-ordination of efforts between the Construction and Bridge Branches regarding the scheduling of certain milestone events.
GC 621 10 (TU2015)	This project is part of a main highway reconstruction program. The overpass is over the railway and replaces an existing structure but at a new location. The site is near a small town and construction must be undertaken with the minimum amount of interference to traffic. The Construction Branch is to provide profiles and datum for design by March 1 and to prepare the necessary drawings

File Code Description

showing elevation and plan views of the location along with all survey information of the site. The Bridge Branch is responsible for the preparation of the submission to the Board of Transport Commissioners. The tentative date of submission is March 15 and the proposed completion date is October 31. It is likely that a precast girder section will be economical, probably type M, with asphalt paving.

For each project being considered for the sample fiscal program, a file code, priority ranking coded structure type, and remarks indicating target dates, proposed structure type, co-ordination required with administrative units outside the Bridge Branch, and any other restrictions related to the project, are noted. Planning an actual fiscal program would require the same type of detail to be enumerated for every project.

The file code given for each project in this sample is hypothetical but would correspond to the filing system used by the Bridge Branch. The structure type coding, in brackets, is derived from the Bridge Structure Categorization scheme outlined in Table I . As indicated in Chapter III, such categorization will be useful for the creation of a data bank of time, cost, and manpower requirements for each activity.

For the purposes of illustration, it has been assumed that; (1) the planned target dates have been approved at the departmental level, and are consistent with the plans of other branches and the long-range plans of the Department; (2) the

most critical target date has been indicated and can be used as a starting point for scheduling; and (3) the restrictions and other data are agreed upon by all concerned. The sample program may then be scheduled.

Listings of the computer input data for each project in the sample fiscal program are shown at the end of this Appendix. The listings indicate the activity number designation which corresponds to the master network diagram, the normal time estimate required to accomplish the activity given the resource assignment, the coding used to designate the organizational unit responsible for performing the activity, the activity name which corresponds to the descriptions in Appendix A, the number of activities following this activity and the labels of the following activities. The time estimates indicated for each activity were derived by means of interviews with the personnel responsible, by data obtained from the files of similar projects, and by means of the author's experience with certain elements of the work. As such, the time estimates are realistic, but cannot be used to make any statements about the operations of the Bridge Branch. The purpose of the sample program is to illustrate the CPM system and not to be exacting in analyzing work contents of specific jobs. As stressed in Chapter IV, time estimates for activities should be provided by the personnel responsible for accomplishing the task.

Each time estimate was derived with respect to the level of manning assigned to the particular activity. For a number of the activities of the Bridge Branch, one person will perform the activity for all projects undertaken. In another case, one person will perform a whole series of activities for a particular project, such as a design engineer performing all the structural design activities on any one project. These considerations are important to bear in mind when decisions are made for recycling or rescheduling the program, and particularly in the resource usage analysis.

Because of space, only the computer output for one project of the sample fiscal program is included at the end of this Appendix. The information obtained is the routine data resulting from the forward and backward passes through the project network. Early start (ES) times, late start (LS) times, early finish (EF) times, late finish (LF) times, free float (FF), and total float (TF) are the basic units of information required for scheduling the projects, and outlining resource requirements. The asterisks beside certain activities serve to indicate that these are critical activities. A variety of reports are obtainable when using the computer. Separate reports for each organizational unit in four different sort routines are available. The use of varying sort routines facilities subsequent analysis because each is a useful format for different purposes.

Assignment of actual calendar dates to the sample fiscal program was done manually. Computer programs are available to perform this task, however, none could be obtained for use by the author. The manual method made use of a calendar schedule as shown in Figure 6, Page 108. This calendar is based on a five day work week, with the legal holidays taken in Alberta shown. Holidays peculiar to an organization can be shown as well. The calendar dating procedure translated the flow-time schedule given in the computer output to specific calendar dates. Because of the unnecessary duplication and the limited time available to complete the thesis, only the complete reports in the order of early start times were calendar dated. This portion of the work is omitted due to space requirements. For scheduling an actual fiscal program, it would be desirable to have all the reports calendar dated to obviate the necessity of reference to these sheets for specific dates.

It was noted during the scheduling phase for project GC621, that a target date for the Board of Transport Commissioners approval was set as March 15, whereas the earliest time it could be accomplished would be April 29. Several alternatives are available to correct this situation, all of which can be assessed before the fiscal program gets underway. The sub-mssion date may be changed in this case if this date is not too critical. The total project may be shifted in time so that this date can be met. The activities preceeding this activity

DAILY STATUS																																	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	MO	YR	
2		1	1						1	1						1	1						1	1						1	JULY	65	Dominion Day
1						1	1						1	1						1	1						1	1			AUG.		
			1	1		2				1	1						1	1						1	1					4	SEPT.		Labor Day
	1	1						1	1	2					1	1						1	1						1	1	OCT.		Thanksgiving
					1	1				2		1	1						1	1						1	1			4	NOV.		Remembrance Day
			1	1						1	1						1	1						2	1						DEC.		Christmas
2	1						1	1						1	1						1	1						1	1		JAN.	66	New Years
				1	1						1	1						1	1						1	1		4	4	4	FEB.		
				1	1						1	1						1	1						1	1					MAR.		
	1	1						1	1						1	1						1	1						1	4	APR.		
1						1	1						1	1						1	1	2					1	1			MAY		Victoria Day
			1	1						1	1						1	1						1	1					4	JUNE		
2	1	1						1	1						1	1						1	1						1	1	JULY		Dominion Day
					1	1						1	1						1	1						1	1				AUG.		
		1	1			2			1	1						1	1						1	1						4	SEPT.		Labor Day
1	1						1	1	2					1	1						1	1						1	1		OCT.		Thanksgiving
				1	1					2	1	1						1	1						1	1				4	NOV.		Remembrance Day
		1	1						1	1						1	1						1	2						1	DEC.		Christmas
2						1	1						1	1						1	1						1	1			JAN.	67	New Years
			1	1						1	1						1	1						1	1			4	4	4	FEB.		
			1	1						1	1						1	1					2	1	1						MAR.		Good Friday
1	1						1	1						1	1						1	1						1	1	4	APR.		
					1	1						1	1						1	1	2					1	1				MAY		Victoria Day
		1	1						1	1						1	1						1	1						4	JUNE		
2	1						1	1						1	1						1	1						1	1		JULY		Dominion Day

LEGEND:
1. Saturday/Sunday
2. Holiday
3. Miscellaneous
4. Day of Month With Less Than 31 Days

Blank Work Day

FIGURE 6. CALENDAR DATING SCHEDULE, FIVE DAY WORK WEEK, ALBERTA HOLIDAYS.

may be moved ahead in time, leaving a lag period until the other activities are started. All these alternatives, or any others thought feasible, may be considered in the light of their effects on the resources usage of the Branch and the effects on the total program.

Figure 7, Page 110, shows a bar chart form of the computer output for the design engineering and design drafting work units. The figure is in terms of specific calendar dates and displays only those activities for which these work groups are responsible. The critical activities and the various categories of float associated with the other activities are detailed in an easily readable form. Charts of this nature would be useful to supervisory personnel of each organizational unit, and are essentially a replacement for the familiar bar chart now used. Other than appearance, the two types of charts have no similarity, whatsoever. The chart derived using CPM is based on, and provides, much more information. Because of the limitations of space, similar figures derived for the other organizational units of the Bridge Branch are not shown.

As may be seen on Figure 7, five of the ten projects, in the sample program, should have the design and drafting work performed during the month of May, if the planned target dates are to be met. However, two projects, file GD621 and file AC5 have 31 and 26 days respectively, of toal float associated with them for this work. Either of them can be moved in time by

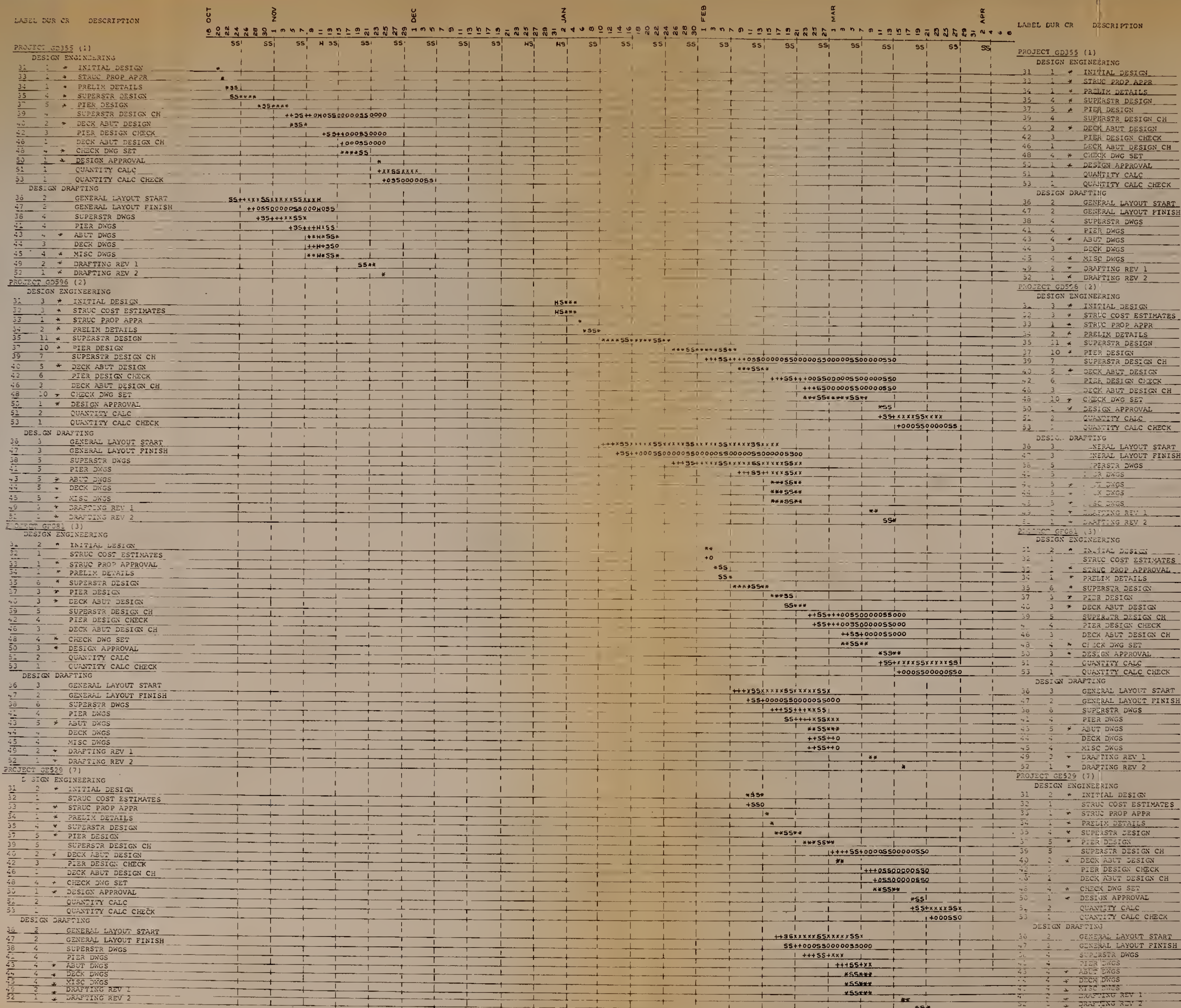


FIGURE 7.
BAR CHART FORM OF DESIGN ENGINEERING AND DESIGN DRAFTING SCHEDULE FOR THE SAMPLE FISCAL PROGRAM

BAR CHART LEGEND

*** CRITICAL ACTIVITY DURATION
+++ NON CRITICAL ACTIVITY DURATION
OOO AMOUNT OF FREE FLOAT
XXX INTERFERING FLOAT
SSS SATURDAY OR SUNDAY, NO WORK
HHH HOLIDAY

SAMPLE FISCAL PROGRAM
DESIGN ENGINEERING
and DESIGN DRAFTING
ACTIVITIES
DWG. No1

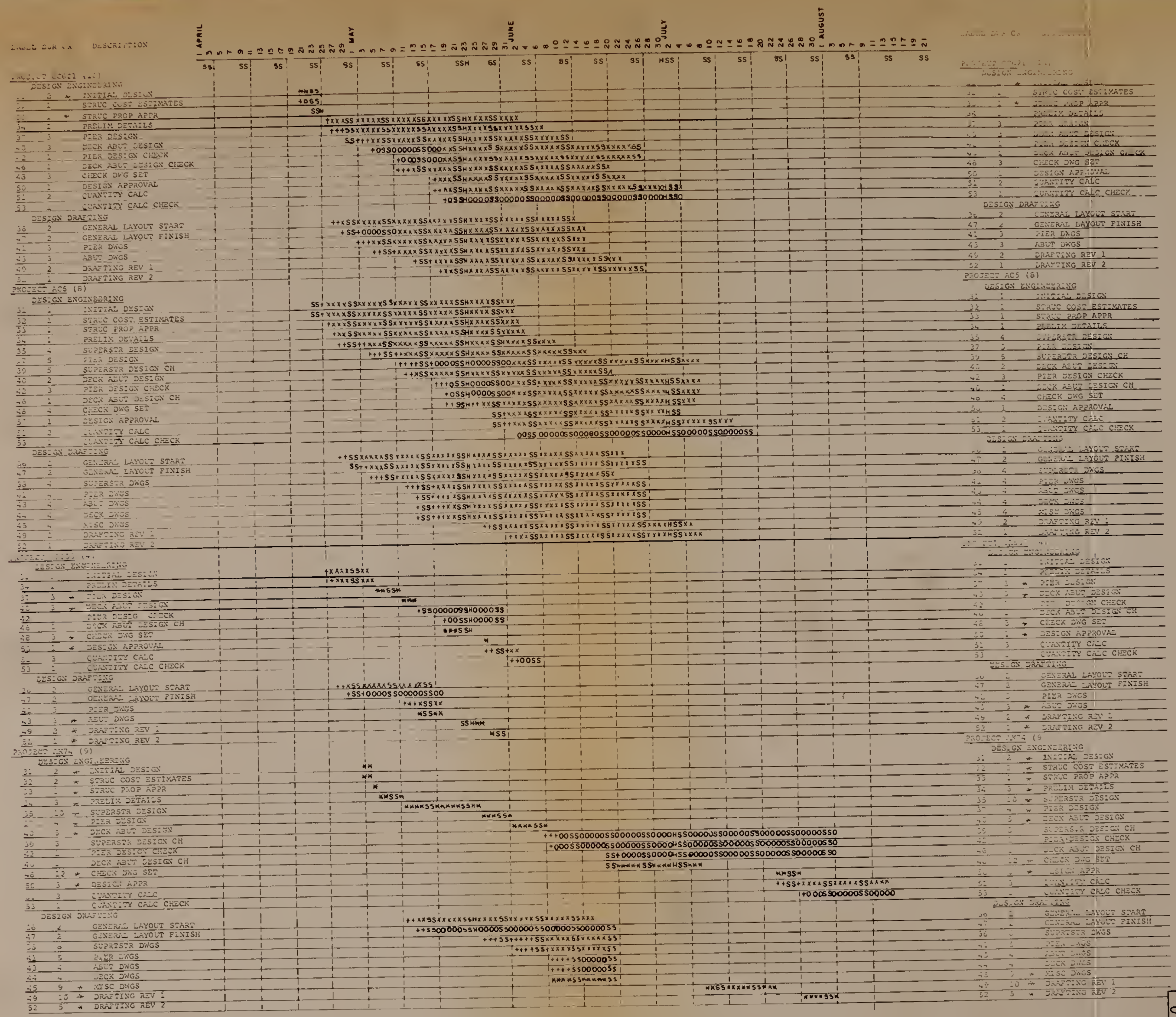


FIGURE 7. CONTINUED

BAR CHART LEGEND

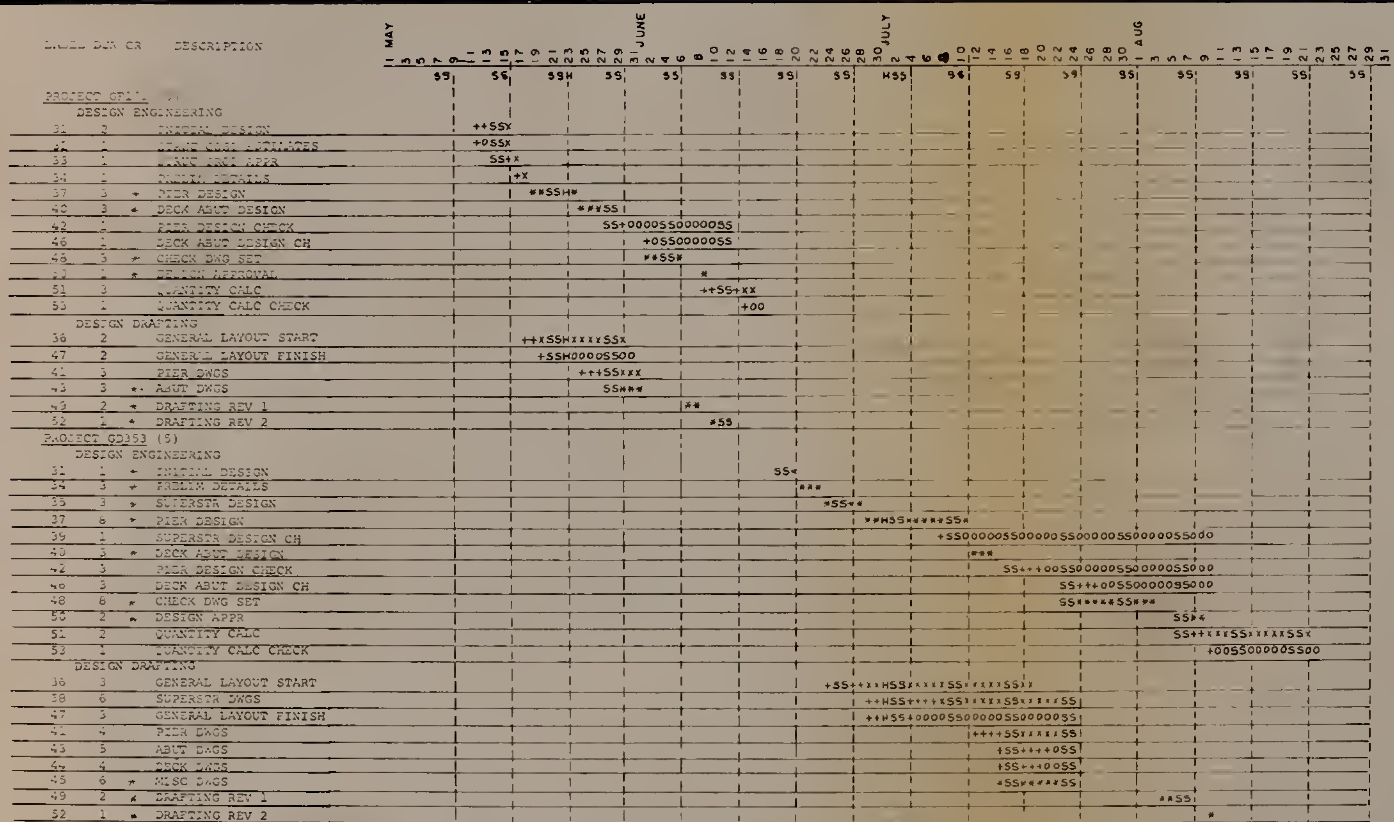
- *** CRITICAL ACTIVITY DURATION
- ††† NON CRITICAL ACTIVITY DURATION
- OOO AMOUNT OF FREE FLOAT
- XXX INTERFERING FLOAT
- SSS SATURDAY OR SUNDAY, NO WORK
- HHH HOLIDAY

SAMPLE FISCAL PROGRAM

DESIGN ENGINEERING and DESIGN DRAFTING ACTIVITIES

DWG. No 2

FIGURE 7. CONTINUED



BAR CHART LEGEND

- *** CRITICAL ACTIVITY DURATION
- ††† NON CRITICAL ACTIVITY DURATION
- OOO AMOUNT OF FREE FLOAT
- XXX INTERFERING FLOAT
- SSS SATURDAY OR SUNDAY, NO WORK
- HHH HOLIDAY

SAMPLE FISCAL PROGRAM

DESIGN ENGINEERING and DESIGN DRAFTING ACTIVITIES

DWG. No 3

these amounts without affecting the project completion date. All the individual design and drafting activities do not have this amount of free float, however, mainly because certain groups of activities need to be performed in a series. An activity with no free float but with some total float cannot be shifted in time without shifting the activities serially associated with it. The high values of total float affiliated with the design and drafting work, result from the fact that these two projects require either a Board of Transport Commissioners approval, approval under the Navigable Waters Act, or that approach roads need to be designed. In project GC621, the Board of Transport Commissioners approval is on the critical path and any desired shortening of this project's total duration is dependent on this fact. In project AC5, approach road design is a critical part of the work, giving rise to the large amount of float associated with the other activities. This project's total duration could be shortened by having the bridge contractor construct the approach fills to the structure, thus releasing the dependency of the bridge work from that of the roadway. Doing this will create a new critical path through the network and the design and drafting work would likely become critical, being shifted later in time by approximately one month. Since these two projects are ranked as eighth and tenth in terms of priorities, it may be desirable to leave them as they are scheduled. This allows the design work group some flexibility

in performing the design and drafting activities on them and so can make more efficient use of their manpower resources.

Figure 8, Page 113, is the resource usage chart for the design engineering and design drafting work groups. This chart was prepared from the schedules, assuming that all activities on all projects would be started at the earliest possible time. Two peak loads are found to be prevalent for the sample program, one in February and one in May. As noted in the preceeding paragraph, by using the float available for projects AC5 and GC621, it may be possible to smooth the resource curves in the May period. This would allow more efficient use of the design engineer's and draftmen's time. During the April and August periods, the need for design and drafting work associated with the sample fiscal program is negligible. These periods could then be available to perform the fill in the extraneous work always present. Personnel could as well be influenced to take holidays during these periods rather than at critical peak periods.

A good deal of analysis can be performed on an initial draft of the schedule such as is shown. Changes in the plan, with respect to target dates and restrictions, can be made to level the resource usage for the Branch well before a fiscal program becomes operative. The ability to see, what the best change to make is and how it affects the total program is a feature of the CPM system.

SAMPLE FISCAL PROGRAM -19xx- BRIDGE BRANCH

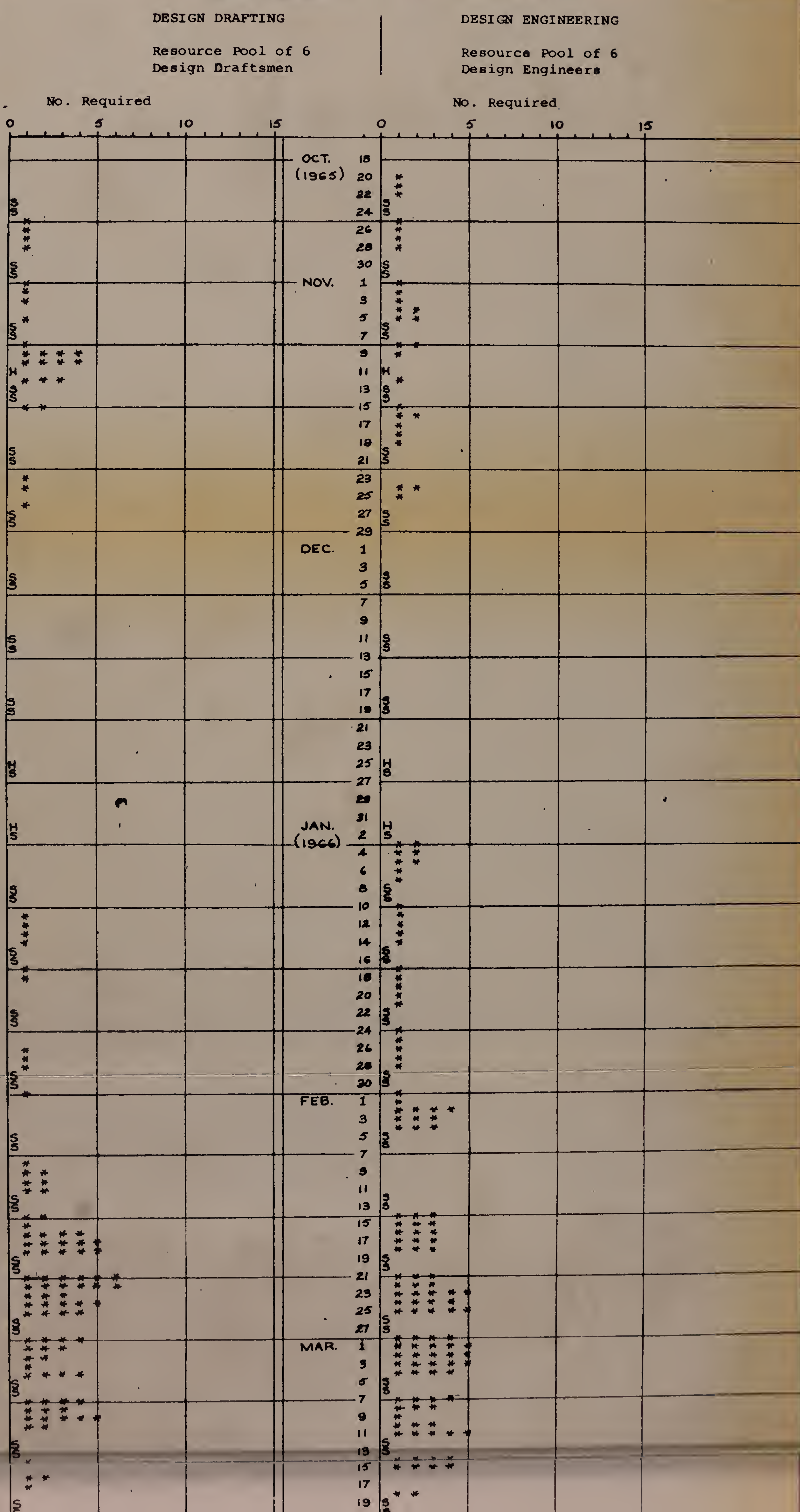
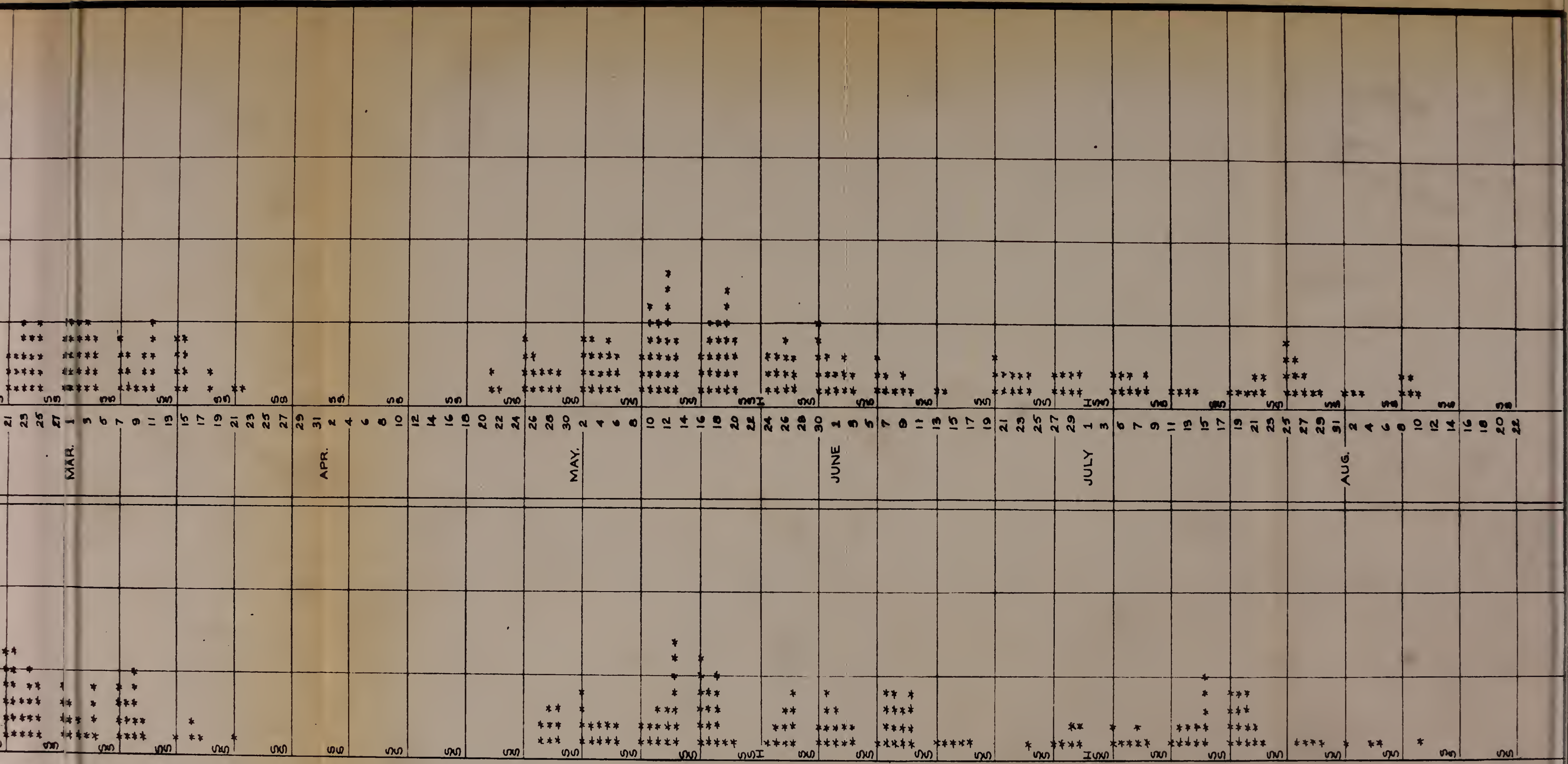


FIGURE 8. RESOURCE USAGE CHART, DESIGN
DESIGN DRAFTING FOR THE SAMPL



ESOURCE USAGE CHART, DESIGN ENGINEERING AND
ESIGN DRAFTING FOR THE SAMPLE FISCAL PROGRAM.

While the preceeding paragraphs describe the type of manipulations that can be done before a fiscal program is undertaken, it must be realized that these same procedures may be used to assess the effects of changes while the program is underway. The ability to forecast the effects of changes on the total program is invaluable to decision making.

It would appear from the resource usage chart shown in Figure 8, that the Bridge Branch is overstaffed. This is far from the actual fact, since it must be emphasized that these charts were derived using the sample fiscal program. An actual fiscal program for the Branch would be three to four times as large. As well, the Branch performs a variety of work not directly associated with the fiscal program and which requires the use of the manpower availabe. Most of this other work is not critical in the sense that it need not be performed on a scheduled basis, and so it may be performed efficiently during lag periods in the fiscal program. Knowing when these periods are about to occur and what personnel will be available to perform them, gives a manager some feeling for his staffing problem.

Further analysis of the sample fiscal program was not undertaken, as there would be little gain from doing so. Any desired changes in the plan or schedule to achieve any desired results are simply recycled and the work performed in a similar manner as has been done initially. This procedure should be

undertaken until the planned fiscal program is acceptable under the circumstances prevailing at the time.

INPUT DATA - PROJECT GD355

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S				
1	00	PE		BRIDGE REQUEST	4	2	3	4	5	
2	00	PE		TRAFFIC ANALYSIS	1	6				
3	0	PE		FIELD RECONN	1	10				
4	0	PE		SITE SURVEY	1	7				
5	02	PE		OFFICE STUDY	1	10				
6	00	PE		TRAFFIC STUDY	1	10				
7	03	PE		PRELIM DESIGN START	5	8	9	10	11	12
8	06	PE		INTER BRANCH APPR	1	15				
9	12	PE		LOCAL AUTHORITY APPR	1	15				
10	03	PE		PRELIM DESIGN FINISH	1	13				
11	02	PE		DD DWGS START	1	14				
12	10	PE		FOUNDATION INVEST	1	37				
13	02	PE		RECONN REPORT	1	15				
14	01	PE		DD DWGS FINISH	1	20				
15	01	PE		RECONN REPORT APPR	3	16	17	18		
16	0	PE		BRIDGE SURVEY	2	19	20			
17	00	AR		RDWY SURVEY START	2	21	22			
18	00	AR		RDWY STANDARDS	1	23				
19	00	PE		RW PLANS BRIDGE	1	25				
20	02	PE		DD DWGS APPROVAL	2	31	32			
21	00	AR		RDWY SURVEY FINISH	1	23				
22	00	AR		RDWY DESIGN START	1	23				
23	00	AR		RDWY DESIGN FINISH	2	24	25			
24	00	AR		RDWY DESIGN APPROVAL	1	26				
25	0	AR	RW	RW PLANS RDWY	1	26				
26	00	AR	RW	RW PURCH AUTHORIZED	1	27				
27	00	AR	RW	RW ACQUIRED	1	77				
31	01	DO	DE	INITIAL DESIGN	1	33				
32	00	DO	DE	STRUC COST ESTIMATES	1	33				
33	01	DO	DE	STRUC PROP APPR	2	34	71			
34	01	DO	DE	PRELIM DETAILS	2	35	36			
35	04	DO	DE	SUPERSTR DESIGN	2	37	38			
36	02	DO	DR	GENERAL LAYOUT START	1	47				
37	05	DO	DE	PIER DESIGN	2	40	41			
38	04	DO	DR	SUPERSTR DWGS	3	39	48	61		
39	04	DO	DE	SUPERSTR DESIGN CH	1	74				
40	02	DO	DE	DECK ABUT DESIGN	3	43	44	45		
41	04	DO	DR	PIER DWGS	2	42	48			
42	03	DO	DE	PIER DESIGN CHECK	1	74				
43	04	DO	DR	ABUT DWGS	2	46	48			
44	03	DO	DR	DECK DWGS	2	46	48			
45	04	DO	DR	MISC DWGS	2	46	48			
46	01	DO	DE	DECK ABUT DESIGN CH	1	74				
47	02	DO	DR	GENERAL LAYOUT FIN	1	48				

INPUT DATA - PROJECT GD355

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	04	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	01	DO	DE	DESIGN APPROVAL	1	52
51	01	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	02	MO		SUPERSTR DESIGN APPR	1	62
62	12	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 76
64	01	MO		CHECK SHOP DWGS A	1	65
65	22	MO		FABRICATION INSP A	1	92
66	06	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	00	MO		CHECK SHOP DWGS B	1	69
69	10	MO		FABRICATION INSP B	1	92
71	00	CA		BTC NWA DWGS	1	72
72	00	CA		BTC NWA SUBMISSION	1	73
73	00	CA		BTC NWA APPROVAL	1	77
74	02	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	01	CA		CONTRACT SCH CONF	1	77
77	01	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	00	CA		REVISION OF DWGS	1	81
80	02	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	01	CA		FINAL APPROVAL DWGS	1	83
83	02	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	13	CA		ADV PROCESS TENDERS	1	86
86	17	CA		CONTRACT SIGNATURE	1	87
87	09	CA		CONTRACT AWARD	1	91
91	88	CO		CONSTRUCTION START	1	92
92	88	CO		CONSTRUCTION FINISH	1	93
93	12	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT GD596

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S				
1	00	PE		BRIDGE REQUEST	4	2	3	4	5	
2	00	PE		TRAFFIC ANALYSIS	1	6				
3	01	PE		FIELD RECONN	1	10				
4	00	PE		SITE SURVEY	1	7				
5	01	PE		OFFICE STUDY	1	10				
6	00	PE		TRAFFIC STUDY	1	10				
7	00	PE		PRELIM DESIGN START	5	8	9	10	11	12
8	00	PE		INTER BRANCH APPR	1	15				
9	00	PE		LOCAL AUTHORITY APPR	1	15				
10	00	PE		PRELIM DESIGN FINISH	1	13				
11	00	PE		DD DWGS START	1	14				
12	06	PE		FOUNDATION INVEST	1	37				
13	00	PE		RECONN REPORT	1	15				
14	00	PE		DD DWGS FINISH	1	20				
15	00	PE		RECONN REPORT APPR	3	16	17	18		
16	00	PE		BRIDGE SURVEY	2	19	20			
17	00	AR		RDWY SURVEY START	2	21	22			
18	00	AR		RDWY STANDARDS	1	23				
19	00	PE		RW PLANS BRIDGE	1	25				
20	00	PE		DD DWGS APPROVAL	2	31	32			
21	00	AR		RDWY SURVEY FINISH	1	23				
22	00	AR		RDWY DESIGN START	1	23				
23	00	AR		RDWY DESIGN FINISH	2	24	25			
24	00	AR		RDWY DESIGN APPROVAL	1	26				
25	00	AR	RW	RW PLANS RDWY	1	26				
26	00	AR	RW	RW PURCH AUTHORIZED	1	27				
27	00	AR	RW	RW ACQUIRED	1	77				
31	03	DO	DE	INITIAL DESIGN	1	33				
32	03	DO	DE	STRUC COST ESTIMATES	1	33				
33	01	DO	DE	STRUC PROP APPR	2	34	71			
34	02	DO	DE	PRELIM DETAILS	2	35	36			
35	11	DO	DE	SUPERSTR DESIGN	2	37	38			
36	03	DO	DR	GENERAL LAYOUT START	1	47				
37	10	DO	DE	PIER DESIGN	2	40	41			
38	05	DO	DR	SUPERSTR DWGS	3	39	48	61		
39	07	DO	DE	SUPERSTR DESIGN CH	1	74				
40	05	DO	DE	DECK ABUT DESIGN	3	43	44	45		
41	05	DO	DR	PIER DWGS	2	42	48			
42	06	DO	DE	PIER DESIGN CHECK	1	74				
43	05	DO	DR	ABUT DWGS	2	46	48			
44	05	DO	DR	DECK DWGS	2	46	48			
45	05	DO	DR	MISC DWGS	2	46	48			
46	03	DO	DE	DECK ABUT DESIGN CH	1	74				
47	03	DO	DR	GENERAL LAYOUT FIN	1	48				

INPUT DATA - PROJECT GD596

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	10	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	01	DO	DE	DESIGN APPROVAL	1	52
51	02	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	02	MO		SUPERSTR DESIGN APPR	1	62
62	12	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 76
64	01	MO		CHECK SHOP DWGS A	1	65
65	15	MO		FABRICATION INSP A	1	92
66	10	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	01	MO		CHECK SHOP DWGS B	1	69
69	10	MO		FABRICATION INSP B	1	92
71	00	CA		BTC NWA DWGS	1	72
72	00	CA		BTC NWA SUBMISSION	1	73
73	00	CA		BTC NWA APPROVAL	1	77
74	03	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	01	CA		CONTRACT SCH CONF	1	77
77	02	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	01	CA		REVISION OF DWGS	1	81
80	01	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	02	CA		FINAL APPROVAL DWGS	1	83
83	03	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	13	CA		ADV PROCESS TENDERS	1	86
86	15	CA		CONTRACT SIGNATURE	1	87
87	07	CA		CONTRACT AWARD	1	91
91	40	CO		CONSTRUCTION START	1	92
92	40	CO		CONSTRUCTION FINISH	1	93
93	12	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT GF081

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
1	00	PE		BRIDGE REQUEST	4	2 3 4 5
2	00	PE		TRAFFIC ANALYSIS	1	6
3	00	PE		FIELD RECONN	1	10
4	00	PE		SITE SURVEY	1	7
5	04	PE		OFFICE STUDY	1	10
6	06	PE		TRAFFIC STUDY	1	10
7	03	PE		PRELIM DESIGN START	5	8 9 10 11 12
8	06	PE		INTER BRANCH APPR	1	15
9	00	PE		LOCAL AUTHORITY APPR	1	15
10	03	PE		PRELIM DESIGN FINISH	1	13
11	02	PE		DD DWGS START	1	14
12	12	PE		FOUNDATION INVEST	1	37
13	02	PE		RECONN REPORT	1	15
14	02	PE		DD DWGS FINISH	1	20
15	01	PE		RECONN REPORT APPR	3	16 17 18
16	00	PE		BRIDGE SURVEY	2	19 20
17	00	AR		RDWY SURVEY START	2	21 22
18	00	AR		RDWY STANDARDS	1	23
19	00	PE		RW PLANS BRIDGE	1	25
20	02	PE		DD DWGS APPROVAL	2	31 32
21	00	AR		RDWY SURVEY FINISH	1	23
22	00	AR		RDWY DESIGN START	1	23
23	00	AR		RDWY DESIGN FINISH	2	24 25
24	00	AR		RDWY DESIGN APPROVAL	1	26
25	00	AR	RW	RW PLANS RDWY	1	26
26	00	AR	RW	RW PURCH AUTHORIZED	1	27
27	00	AR	RW	RW ACQUIRED	1	77
31	02	DO	DE	INITIAL DESIGN	1	33
32	01	DO	DE	STRUC COST ESTIMATES	1	33
33	01	DO	DE	STRUC PROP APPR	2	34 71
34	01	DO	DE	PRELIM DETAILS	2	35 36
35	06	DO	DE	SUPERSTR DESIGN	2	37 38
36	03	DO	DR	GENERAL LAYOUT START	1	47
37	03	DO	DE	PIER DESIGN	2	40 41
38	06	DO	DR	SUPERSTR DWGS	3	39 48 61
39	05	DO	DE	SUPERSTR DESIGN CH	1	74
40	03	DO	DE	DECK ABUT DESIGN	3	43 44 45
41	04	DO	DR	PIER DWGS	2	42 48
42	04	DO	DE	PIER DESIGN CHECK	1	74
43	05	DO	DR	ABUT DWGS	2	46 48
44	04	DO	DR	DECK DWGS	2	46 48
45	04	DO	DR	MISC DWGS	2	46 48
46	03	DO	DE	DECK ABUT DESIGN CH	1	74
47	02	DO	DR	GENERAL LAYOUT FIN	1	48

INPUT DATA - PROJECT GF081

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	04	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	03	DO	DE	DESIGN APPROVAL	1	52
51	02	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	02	MO		SUPERSTR DESIGN APPR	1	62
62	13	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 76
64	01	MO		CHECK SHOP DWGS A	1	65
65	18	MO		FABRICATION INSP A	1	92
66	10	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	01	MO		CHECK SHOP DWGS B	1	69
69	15	MO		FABRICATION INSP B	1	92
71	00	CA		BTC NWA DWGS	1	72
72	00	CA		BTC NWA SUBMISSION	1	73
73	00	CA		BTC NWA APPROVAL	1	77
74	02	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	01	CA		CONTRACT SCH CONF	1	77
77	02	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	01	CA		REVISION OF DWGS	1	81
80	02	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	02	CA		FINAL APPROVAL DWGS	1	83
83	02	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	14	CA		ADV PROCESS TENDERS	1	86
86	15	CA		CONTRACT SIGNATURE	1	87
87	08	CA		CONTRACT AWARD	1	91
91	44	CO		CONSTRUCTION START	1	92
92	44	CO		CONSTRUCTION FINISH	1	93
93	10	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT GD599

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
1	00	PE		BRIDGE REQUEST	4	2 3 4 5
2	00	PE		TRAFFIC ANALYSIS	1	6
3	01	PE		FIELD RECONN	1	10
4	00	PE		SITE SURVEY	1	7
5	00	PE		OFFICE STUDY	1	10
6	00	PE		TRAFFIC STUDY	1	10
7	00	PE		PRELIM DESIGN START	5	8 9 10 11 12
8	00	PE		INTER BRANCH APPR	1	15
9	00	PE		LOCAL AUTHORITY APPR	1	15
10	00	PE		PRELIM DESIGN FINISH	1	13
11	00	PE		DD DWGS START	1	14
12	09	PE		FOUNDATION INVEST	1	37
13	00	PE		RECONN REPORT	1	15
14	00	PE		DD DWGS FINISH	1	20
15	00	PE		RECONN REPORT APPR	3	16 17 18
16	00	PE		BRIDGE SURVEY	2	19 20
17	00	AR		RDWY SURVEY START	2	21 22
18	00	AR		RDWY STANDARDS	1	23
19	00	PE		RW PLANS BRIDGE	1	25
20	00	PE		DD DWGS APPROVAL	2	31 32
21	00	AR		RDWY SURVEY FINISH	1	23
22	00	AR		RDWY DESIGN START	1	23
23	00	AR		RDWY DESIGN FINISH	2	24 25
24	00	AR		RDWY DESIGN APPROVAL	1	26
25	00	AR	RW	RW PLANS RDWY	1	26
26	00	AR	RW	RW PURCH AUTHORIZED	1	27
27	00	AR	RW	RW ACQUIRED	1	77
31	01	DO	DE	INITIAL DESIGN	1	33
32	00	DO	DE	STRUC COST ESTIMATES	1	33
33	00	DO	DE	STRUC PROP APPR	2	34 71
34	01	DO	DE	PRELIM DETAILS	2	35 36
35	00	DO	DE	SUPERSTR DESIGN	2	37 38
36	02	DO	DR	GENERAL LAYOUT START	1	47
37	03	DO	DE	PIER DESIGN	2	40 41
38	00	DO	DR	SUPERSTR DWGS	3	39 48 61
39	00	DO	DE	SUPERSTR DESIGN CH	1	74
40	03	DO	DE	DECK ABUT DESIGN	3	43 44 45
41	03	DO	DR	PIER DWGS	2	42 48
42	01	DO	DE	PIER DESIGN CHECK	1	74
43	03	DO	DR	ABUT DWGS	2	46 48
44	00	DO	DR	DECK DWGS	2	46 48
45	00	DO	DR	MISC DWGS	2	46 48
46	01	DO	DE	DECK ABUT DESIGN CH	1	74
47	02	DO	DR	GENERAL LAYOUT FIN	1	48

INPUT DATA - PROJECT GD599

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S		
48	03	DO	DE	CHECK DWG SET	1	49		
49	02	DO	DR	DRAFTING REV 1	2	50	51	
50	01	DO	DE	DESIGN APPROVAL	1	52		
51	03	DO	DE	QUANTITY CALC	1	53		
52	01	DO	DR	DRAFTING REV 2	3	74	75	66
53	01	DO	DE	QUANTITY CALC CHECK	1	81		
61	01	MO		SUPERSTR DESIGN APPR	1	62		
62	02	MO		REQUISITION SUPPLY A	1	63		
63	01	MO		TENDER APPR A	2	64	76	
64	01	MO		CHECK SHOP DWGS A	1	65		
65	03	MO		FABRICATION INSP A	1	92		
66	06	MO		REQUISITION SUPPLY B	1	67		
67	01	MO		TENDER APPR B	1	68		
68	00	MO		CHECK SHOP DWGS B	1	69		
69	02	MO		FABRICATION INSP B	1	92		
71	00	CA		BTC NWA DWGS	1	72		
72	00	CA		BTC NWA SUBMISSION	1	73		
73	00	CA		BTC NWA APPROVAL	1	77		
74	01	CA		CHECK DWGS CONST	1	75		
75	01	CA		CHECK DWGS CONTRACT	1	76		
76	00	CA		CONTRACT SCH CONF	1	77		
77	01	CA		SPEC PROV DRAFTED	3	78	80	81
78	01	CA		SPEC PROV APPROVAL	1	79		
79	00	CA		REVISION OF DWGS	1	81		
80	01	CA		PERMISSION TO ADV	1	85		
81	01	CA		PREP SAMPLE CONTRACT	2	82	84	
82	01	CA		FINAL APPROVAL DWGS	1	83		
83	01	CA		DWG SETS PREPARED	1	85		
84	01	CA		CONTRACT ASSEMBLY	1	85		
85	12	CA		ADV PROCESS TENDERS	1	86		
86	12	CA		CONTRACT SIGNATURE	1	87		
87	05	CA		CONTRACT AWARD	1	91		
91	15	CO		CONSTRUCTION START	1	92		
92	15	CO		CONSTRUCTION FINISH	1	93		
93	10	CO		CONTRACT TERMINATION	0			

INPUT DATA - PROJECT GD353

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
1	00	PE		BRIDGE REQUEST	4	2 3 4 5
2	00	PE		TRAFFIC ANALYSIS	1	6
3	02	PE		FIELD RECONN	1	10
4	10	PE		SITE SURVEY	1	7
5	06	PE		OFFICE STUDY	1	10
6	02	PE		TRAFFIC STUDY	1	10
7	07	PE		PRELIM DESIGN START	5	8 9 10 11 12
8	04	PE		INTER BRANCH APPR	1	15
9	00	PE		LOCAL AUTHORITY APPR	1	15
10	07	PE		PRELIM DESIGN FINISH	1	13
11	03	PE		DD DWGS START	1	14
12	10	PE		FOUNDATION INVEST	1	37
13	02	PE		RECONN REPORT	1	15
14	03	PE		DD DWGS FINISH	1	20
15	01	PE		RECONN REPORT APPR	3	16 17 18
16	00	PE		BRIDGE SURVEY	2	19 20
17	00	AR		RDWY SURVEY START	2	21 22
18	00	AR		RDWY STANDARDS	1	23
19	00	PE		RW PLANS BRIDGE	1	25
20	02	PE		DD DWGS APPROVAL	2	31 32
21	00	AR		RDWY SURVEY FINISH	1	23
22	00	AR		RDWY DESIGN START	1	23
23	00	AR		RDWY DESIGN FINISH	2	24 25
24	00	AR		RDWY DESIGN APPROVAL	1	26
25	00	AR	RW	RW PLANS RDWY	1	26
26	00	AR	RW	RW PURCH AUTHORIZED	1	27
27	00	AR	RW	RW ACQUIRED	1	77
31	01	DO	DE	INITIAL DESIGN	1	33
32	00	DO	DE	STRUC COST ESTIMATES	1	33
33	00	DO	DE	STRUC PROP APPR	2	34 71
34	03	DO	DE	PRELIM DETAILS	2	35 36
35	03	DO	DE	SUPERSTR DESIGN	2	37 38
36	03	DO	DR	GENERAL LAYOUT START	1	47
37	08	DO	DE	PIER DESIGN	2	40 41
38	06	DO	DR	SUPERSTR DWGS	3	39 48 61
39	01	DO	DE	SUPERSTR DESIGN CH	1	74
40	03	DO	DE	DECK ABUT DESIGN	3	43 44 45
41	04	DO	DR	PIER DWGS	2	42 48
42	03	DO	DE	PIER DESIGN CHECK	1	74
43	05	DO	DR	ABUT DWGS	2	46 48
44	04	DO	DR	DECK DWGS	2	46 48
45	06	DO	DR	MISC DWGS	2	46 48
46	03	DO	DE	DECK ABUT DESIGN CH	1	74
47	03	DO	DR	GENERAL LAYOUT FIN	1	48

INPUT DATA - PROJECT GD353

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	08	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	02	DO	DE	DESIGN APPROVAL	1	52
51	02	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	00	MO		SUPERSTR DESIGN APPR	1	62
62	00	MO		REQUISITION SUPPLY A	1	63
63	00	MO		TENDER APPR A	2	64 76
64	00	MO		CHECK SHOP DWGS A	1	65
65	00	MO		FABRICATION INSP A	1	92
66	06	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	01	MO		CHECK SHOP DWGS B	1	69
69	05	MO		FABRICATION INSP B	1	92
71	00	CA		BTC NWA DWGS	1	72
72	00	CA		BTC NWA SUBMISSION	1	73
73	00	CA		BTC NWA APPROVAL	1	77
74	02	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	02	CA		CONTRACT SCH CONF	1	77
77	02	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	01	CA		REVISION OF DWGS	1	81
80	02	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	02	CA		FINAL APPROVAL DWGS	1	83
83	03	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	13	CA		ADV PROCESS TENDERS	1	86
86	15	CA		CONTRACT SIGNATURE	1	87
87	09	CA		CONTRACT AWARD	1	91
91	50	CO		CONSTRUCTION START	1	92
92	50	CO		CONSTRUCTION FINISH	1	93
93	15	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT GF102

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S				
1	00	PE		BRIDGE REQUEST	4	2	3	4	5	
2	00	PE		TRAFFIC ANALYSIS	1	6				
3	01	PE		FIELD RECONN	1	10				
4	00	PE		SITE SURVEY	1	7				
5	01	PE		OFFICE STUDY	1	10				
6	00	PE		TRAFFIC STUDY	1	10				
7	00	PE		PRELIM DESIGN START	5	8	9	10	11	12
8	00	PE		INTER BRANCH APPR	1	15				
9	00	PE		LOCAL AUTHORITY APPR	1	15				
10	00	PE		PRELIM DESIGN FINISH	1	13				
11	00	PE		DD DWGS START	1	14				
12	06	PE		FOUNDATION INVEST	1	37				
13	00	PE		RECONN REPORT	1	15				
14	00	PE		DD DWGS FINISH	1	20				
15	00	PE		RECONN REPORT APPR	3	16	17	18		
16	00	PE		BRIDGE SURVEY	2	19	20			
17	00	AR		RDWY SURVEY START	2	21	22			
18	00	AR		RDWY STANDARDS	1	23				
19	00	PE		RW PLANS BRIDGE	1	25				
20	00	PE		DD DWGS APPROVAL	2	31	32			
21	00	AR		RDWY SURVEY FINISH	1	23				
22	00	AR		RDWY DESIGN START	1	23				
23	00	AR		RDWY DESIGN FINISH	2	24	25			
24	00	AR		RDWY DESIGN APPROVAL	1	26				
25	00	AR	RW	RW PLANS RDWY	1	26				
26	00	AR	RW	RW PURCH AUTHORIZED	1	27				
27	00	AR	RW	RW ACQUIRED	1	77				
31	02	DO	DE	INITIAL DESIGN	1	33				
32	01	DO	DE	STRUC COST ESTIMATES	1	33				
33	01	DO	DE	STRUC PROP APPR	2	34	71			
34	01	DO	DE	PRELIM DETAILS	2	35	36			
35	00	DO	DE	SUPERSTR DESIGN	2	37	38			
36	02	DO	DR	GENERAL LAYOUT START	1	47				
37	03	DO	DE	PIER DESIGN	2	40	41			
38	00	DO	DR	SUPERSTR DWGS	3	39	48	61		
39	00	DO	DE	SUPERSTR DESIGN CH	1	74				
40	03	DO	DE	DECK ABUT DESIGN	3	43	44	45		
41	03	DO	DR	PIER DWGS	2	42	48			
42	01	DO	DE	PIER DESIGN CHECK	1	74				
43	03	DO	DR	ABUT DWGS	2	46	48			
44	00	DO	DR	DECK DWGS	2	46	48			
45	00	DO	DR	MISC DWGS	2	46	48			
46	01	DO	DE	DECK ABUT DESIGN CH	1	74				
47	02	DO	DR	GENERAL LAYOUT FIN	1	48				

INPUT DATA - PROJECT GF102

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	03	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	01	DO	DE	DESIGN APPROVAL	1	52
51	03	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	01	MO		SUPERSTR DESIGN APPR	1	62
62	12	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 76
64	01	MO		CHECK SHOP DWGS A	1	65
65	05	MO		FABRICATION INSP A	1	92
66	06	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	00	MO		CHECK SHOP DWGS B	1	69
69	04	MO		FABRICATION INSP B	1	92
71	00	CA		BTC NWA DWGS	1	72
72	00	CA		BTC NWA SUBMISSION	1	73
73	00	CA		BTC NWA APPROVAL	1	77
74	01	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	00	CA		CONTRACT SCH CONF	1	77
77	01	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	00	CA		REVISION OF DWGS	1	81
80	01	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	01	CA		FINAL APPROVAL DWGS	1	83
83	01	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	12	CA		ADV PROCESS TENDERS	1	86
86	12	CA		CONTRACT SIGNATURE	1	87
87	05	CA		CONTRACT AWARD	1	91
91	20	CO		CONSTRUCTION START	1	92
92	20	CO		CONSTRUCTION FINISH	1	93
93	10	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT GE529

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
1	00	PE		BRIDGE REQUEST	4	2 3 4 5
2	00	PE		TRAFFIC ANALYSIS	1	6
3	00	PE		FIELD RECONN	1	10
4	00	PE		SITE SURVEY	1	7
5	03	PE		OFFICE STUDY	1	10
6	01	PE		TRAFFIC STUDY	1	10
7	05	PE		PRELIM DESIGN START	5	8 9 10 11 12
8	06	PE		INTER BRANCH APPR	1	15
9	00	PE		LOCAL AUTHORITY APPR	1	15
10	05	PE		PRELIM DESIGN FINISH	1	13
11	02	PE		DD DWGS START	1	14
12	10	PE		FOUNDATION INVEST	1	37
13	02	PE		RECONN REPORT	1	15
14	01	PE		DD DWGS FINISH	1	20
15	01	PE		RECONN REPORT APPR	3	16 17 18
16	02	PE		BRIDGE SURVEY	2	19 20
17	00	AR		RDWY SURVEY START	2	21 22
18	00	AR		RDWY STANDARDS	1	23
19	00	PE		RW PLANS BRIDGE	1	25
20	02	PE		DD DWGS APPROVAL	2	31 32
21	00	AR		RDWY SURVEY FINISH	1	23
22	00	AR		RDWY DESIGN START	1	23
23	00	AR		RDWY DESIGN FINISH	2	24 25
24	00	AR		RDWY DESIGN APPROVAL	1	26
25	00	AR	RW	RW PLANS RDWY	1	26
26	00	AR	RW	RW PURCH AUTHORIZED	1	27
27	00	AR	RW	RW ACQUIRED	1	77
31	02	DO	DE	INITIAL DESIGN	1	33
32	01	DO	DE	STRUC COST ESTIMATES	1	33
33	01	DO	DE	STRUC PROP APPR	2	34 71
34	01	DO	DE	PRELIM DETAILS	2	35 36
35	04	DO	DE	SUPERSTR DESIGN	2	37 38
36	02	DO	DR	GENERAL LAYOUT START	1	47
37	05	DO	DE	PIER DESIGN	2	40 41
38	04	DO	DR	SUPERSTR DWGS	3	39 48 61
39	05	DO	DE	SUPERSTR DESIGN CH	1	74
40	02	DO	DE	DECK ABUT DESIGN	3	43 44 45
41	04	DO	DR	PIER DWGS	2	42 48
42	03	DO	DE	PIER DESIGN CHECK	1	74
43	04	DO	DR	ABUT DWGS	2	46 48
44	04	DO	DR	DECK DWGS	2	46 48
45	04	DO	DR	MISC DWGS	2	46 48
46	01	DO	DE	DECK ABUT DESIGN CH	1	74
47	02	DO	DR	GENERAL LAYOUT FIN	1	48

INPUT DATA - PROJECT GE529

LABEL	DUR	CO1	CO2	DESCRIPTION	NFA	FOLLOWING ACT.S
1	00	PE		BRIDGE REQUEST	4	2 3 4 5
2	00	PE		TRAFFIC ANALYSIS	1	6
3	00	PE		FIELD RECONN	1	10
4	00	PE		SITE SURVEY	1	7
5	03	PE		OFFICE STUDY	1	10
6	01	PE		TRAFFIC STUDY	1	10
7	05	PE		PRELIM DESIGN START	5	8 9 10 11 12
8	06	PE		INTER BRANCH APPR	1	15
9	00	PE		LOCAL AUTHORITY APPR	1	15
10	05	PE		PRELIM DESIGN FINISH	1	13
11	02	PE		DD DWGS START	1	14
12	10	PE		FOUNDATION INVEST	1	37
13	02	PE		RECONN REPORT	1	15
14	01	PE		DD DWGS FINISH	1	20
15	01	PE		RECONN REPORT APPR	3	16 17 18
16	02	PE		BRIDGE SURVEY	2	19 20
17	00	AR		RDWY SURVEY START	2	21 22
18	00	AR		RDWY STANDARDS	1	23
19	00	PE		RW PLANS BRIDGE	1	25
20	02	PE		DD DWGS APPROVAL	2	31 32
21	00	AR		RDWY SURVEY FINISH	1	23
22	00	AR		RDWY DESIGN START	1	23
23	00	AR		RDWY DESIGN FINISH	2	24 25
24	00	AR		RDWY DESIGN APPROVAL	1	26
25	00	AR	RW	RW PLANS RDWY	1	26
26	00	AR	RW	RW PURCH AUTHORIZED	1	27
27	00	AR	RW	RW ACQUIRED	1	77
31	02	DD	DE	INITIAL DESIGN	1	33
32	01	DD	DE	STRUC COST ESTIMATES	1	33
33	01	DD	DE	STRUC PROP APPR	2	34 71
34	01	DD	DE	PRELIM DETAILS	2	35 36
35	04	DD	DE	SUPERSTR DESIGN	2	37 38
36	02	DD	DR	GENERAL LAYOUT START	1	47
37	05	DD	DE	PIER DESIGN	2	40 41
38	04	DD	DR	SUPERSTR DWGS	3	39 48 61
39	05	DD	DE	SUPERSTR DESIGN CH	1	74
40	02	DD	DE	DECK ABUT DESIGN	3	43 44 45
41	04	DD	DR	PIER DWGS	2	42 48
42	03	DD	DE	PIER DESIGN CHECK	1	74
43	04	DD	DR	ABUT DWGS	2	46 48
44	04	DD	DR	DECK DWGS	2	46 48
45	04	DD	DR	MISC DWGS	2	46 48
46	01	DD	DE	DECK ABUT DESIGN CH	1	74
47	02	DD	DR	GENERAL LAYOUT FIN	1	48

INPUT DATA - PROJECT GE529

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	04	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	01	DO	DE	DESIGN APPROVAL	1	52
51	02	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	02	MO		SUPERSTR DESIGN APPR	1	62
62	12	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 76
64	01	MO		CHECK SHOP DWGS A	1	65
65	15	MO		FABRICATION INSP A	1	92
66	10	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	00	MO		CHECK SHOP DWGS B	1	69
69	05	MO		FABRICATION INSP B	1	92
71	00	CA		BTC NWA DWGS	1	72
72	00	CA		BTC NWA SUBMISSION	1	73
73	00	CA		BTC NWA APPROVAL	1	77
74	02	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	01	CA		CONTRACT SCH CONF	1	77
77	01	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	00	CA		REVISION OF DWGS	1	81
80	01	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	01	CA		FINAL APPROVAL DWGS	1	83
83	02	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	13	CA		ADV PROCESS TENDERS	1	86
86	15	CA		CONTRACT SIGNATURE	1	87
87	08	CA		CONTRACT AWARD	1	91
91	45	CO		CONSTRUCTION START	1	92
92	45	CO		CONSTRUCTION FINISH	1	93
93	10	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT AC5

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
1	00	PE		BRIDGE REQUEST	4	2 3 4 5
2	00	PE		TRAFFIC ANALYSIS	1	6
3	00	PE		FIELD RECONN	1	10
4	00	PE		SITE SURVEY	1	7
5	00	PE		OFFICE STUDY	1	10
6	00	PE		TRAFFIC STUDY	1	10
7	00	PE		PRELIM DESIGN START	5	8 9 10 11 12
8	00	PE		INTER BRANCH APPR	1	15
9	00	PE		LOCAL AUTHORITY APPR	1	15
10	00	PE		PRELIM DESIGN FINISH	1	13
11	02	PE		DD DWGS START	1	14
12	10	PE		FOUNDATION INVEST	1	37
13	00	PE		RECONN REPORT	1	15
14	01	PE		DD DWGS FINISH	1	20
15	00	PE		RECONN REPORT APPR	3	16 17 18
16	00	PE		BRIDGE SURVEY	2	19 20
17	15	AR		RDWY SURVEY START	2	21 22
18	01	AR		RDWY STANDARDS	1	23
19	02	PE		RW PLANS BRIDGE	1	25
20	02	PE		DD DWGS APPROVAL	2	31 32
21	15	AR		RDWY SURVEY FINISH	1	23
22	12	AR		RDWY DESIGN START	1	23
23	12	AR		RDWY DESIGN FINISH	2	24 25
24	03	AR		RDWY DESIGN APPROVAL	1	26
25	02	AR	RW	RW PLANS RDWY	1	26
26	01	AR	RW	RW PURCH AUTHORIZED	1	27
27	15	AR	RW	RW ACQUIRED	1	77
31	01	DO	DE	INITIAL DESIGN	1	33
32	01	DO	DE	STRUC COST ESTIMATES	1	33
33	01	DO	DE	STRUC PROP APPR	2	34 71
34	01	DO	DE	PRELIM DETAILS	2	35 36
35	04	DO	DE	SUPERSTR DESIGN	2	37 38
36	02	DO	DR	GENERAL LAYOUT START	1	47
37	05	DO	DE	PIER DESIGN	2	40 41
38	04	DO	DR	SUPERSTR DWGS	3	39 48 61
39	05	DO	DE	SUPERSTR DESIGN CH	1	74
40	02	DO	DE	DECK ABUT DESIGN	3	43 44 45
41	04	DO	DR	PIER DWGS	2	42 48
42	03	DO	DE	PIER DESIGN CHECK	1	74
43	04	DO	DR	ABUT DWGS	2	46 48
44	04	DO	DR	DECK DWGS	2	46 48
45	04	DO	DR	MISC DWGS	2	46 48
46	01	DO	DE	DECK ABUT DESIGN CH	1	74
47	02	DO	DR	GENERAL LAYOUT FIN	1	48

INPUT DATA - PROJECT AC5

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT.S
1	00	PE		BRIDGE REQUEST	4	2 3 4 5
2	00	PE		TRAFFIC ANALYSIS	1	6
3	00	PE		FIELD RECOMM	1	10
4	00	PE		SITE SURVEY	1	7
5	00	PE		OFFICE STUDY	1	10
6	00	PE		TRAFFIC STUDY	1	10
7	00	PE		PRELIM DESIGN START	5	8 9 10 11 12
8	00	PE		INTER BRANCH APPR	1	15
9	00	PE		LOCAL AUTHORITY APPR	1	15
10	00	PE		PRELIM DESIGN FINISH	1	13
11	02	PE		DD DWGS START	1	14
12	10	PE		FOUNDATION INVEST	1	37
13	00	PE		RECOMM REPORT	1	15
14	01	PE		DD DWGS FINISH	1	20
15	00	PE		RECOMM REPORT APPR	3	16 17 18
16	00	PE		BRIDGE SURVEY	2	19 20
17	15	AR		RDWY SURVEY START	2	21 22
18	01	AR		RDWY STANDARDS	1	23
19	02	PE		RW PLANS BRIDGE	1	25
20	02	PE		DD DWGS APPROVAL	2	31 32
21	15	AR		RDWY SURVEY FINISH	1	23
22	12	AR		RDWY DESIGN START	1	23
23	12	AR		RDWY DESIGN FINISH	2	24 25
24	03	AR		RDWY DESIGN APPROVAL	1	26
25	02	AR	RW	RW PLANS RDWY	1	26
26	01	AR	RW	RW PURCH AUTHORIZED	1	27
27	15	AR	RW	RW ACQUIRED	1	77
31	01	DO	DE	INITIAL DESIGN	1	33
32	01	DO	DE	STRUC COST ESTIMATES	1	33
33	01	DO	DE	STRUC PROP APPR	2	34 71
34	01	DO	DE	PRELIM DETAILS	2	35 36
35	04	DO	DE	SUPERSTR DESIGN	2	37 38
36	02	DO	DR	GENERAL LAYOUT START	1	47
37	05	DO	DE	PIER DESIGN	2	40 41
38	04	DO	DR	SUPERSTR DWGS	3	39 48 61
39	05	DO	DE	SUPERSTR DESIGN CH	1	74
40	02	DO	DE	DECK ABUT DESIGN	3	43 44 45
41	04	DO	DR	PIER DWGS	2	42 48
42	03	DO	DE	PIER DESIGN CHECK	1	74
43	04	DO	DR	ABUT DWGS	2	46 48
44	04	DO	DR	DECK DWGS	2	46 48
45	04	DO	DR	MISC DWGS	2	46 48
46	01	DO	DE	DECK ABUT DESIGN CH	1	74
47	02	DO	DR	GENERAL LAYOUT FIN	1	48

INPUT DATA - PROJECT AC5

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	04	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	01	DO	DE	DESIGN APPROVAL	1	52
51	02	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	02	MO		SUPERSTR DESIGN APPR	1	62
62	12	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 76
64	01	MO		CHECK SHOP DWGS A	1	65
65	15	MO		FABRICATION INSP A	1	92
66	06	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	00	MO		CHECK SHOP DWGS B	1	69
69	08	MO		FABRICATION INSP B	1	92
71	03	CA		BTC NWA DWGS	1	72
72	02	CA		BTC NWA SUBMISSION	1	73
73	18	CA		BTC NWA APPROVAL	1	77
74	02	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	01	CA		CONTRACT SCH CONF	1	77
77	01	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	00	CA		REVISION OF DWGS	1	81
80	02	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	02	CA		FINAL APPROVAL DWGS	1	83
83	03	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	13	CA		ADV PROCESS TENDERS	1	86
86	12	CA		CONTRACT SIGNATURE	1	87
87	08	CA		CONTRACT AWARD	1	91
91	60	CO		CONSTRUCTION START	1	92
92	60	CO		CONSTRUCTION FINISH	1	93
93	12	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT AK74

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S				
1	00	PE		BRIDGE REQUEST	4	2	3	4	5	
2	00	PE		TRAFFIC ANALYSIS	1	6				
3	00	PE		FIELD RECONN	1	10				
4	00	PE		SITE SURVEY	1	7				
5	05	PE		OFFICE STUDY	1	10				
6	03	PE		TRAFFIC STUDY	1	10				
7	10	PE		PRELIM DESIGN START	5	8	9	10	11	12
8	06	PE		INTER BRANCH APPR	1	15				
9	00	PE		LOCAL AUTHORITY APPR	1	15				
10	10	PE		PRELIM DESIGN FINISH	1	13				
11	04	PE		DD DWGS START	1	14				
12	02	PE		FOUNDATION INVEST	1	37				
13	03	PE		RECONN REPORT	1	15				
14	04	PE		DD DWGS FINISH	1	20				
15	01	PE		RECONN REPORT APPR	3	16	17	18		
16	02	PE		BRIDGE SURVEY	2	19	20			
17	00	AR		RDWY SURVEY START	2	21	22			
18	00	AR		RDWY STANDARDS	1	23				
19	00	PE		RW PLANS BRIDGE	1	25				
20	03	PE		DD DWGS APPROVAL	2	31	32			
21	22	AR		RDWY SURVEY FINISH	1	23				
22	00	AR		RDWY DESIGN START	1	23				
23	20	AR		RDWY DESIGN FINISH	2	24	25			
24	06	AR		RDWY DESIGN APPROVAL	1	26				
25	03	AR	RW	RW PLANS RDWY	1	26				
26	01	AR	RW	RW PURCH AUTHORIZED	1	27				
27	12	AR	RW	RW ACQUIRED	1	77				
31	02	DO	DE	INITIAL DESIGN	1	33				
32	02	DO	DE	STRUC COST ESTIMATES	1	33				
33	01	DO	DE	STRUC PROP APPR	2	34	71			
34	03	DO	DE	PRELIM DETAILS	2	35	36			
35	10	DO	DE	SUPERSTR DESIGN	2	37	38			
36	02	DO	DR	GENERAL LAYOUT START	1	47				
37	04	DO	DE	PIER DESIGN	2	40	41			
38	08	DO	DR	SUPERSTR DWGS	3	39	48	61		
39	03	DO	DE	SUPERSTR DESIGN CH	1	74				
40	05	DO	DE	DECK ABUT DESIGN	3	43	44	45		
41	05	DO	DR	PIER DWGS	2	42	48			
42	01	DO	DE	PIER DESIGN CHECK	1	74				
43	04	DO	DR	ABUT DWGS	2	46	48			
44	04	DO	DR	DECK DWGS	2	46	48			
45	09	DO	DR	MISC DWGS	2	46	48			
46	01	DO	DE	DECK ABUT DESIGN CH	1	74				
47	02	DO	DR	GENERAL LAYOUT FIN	1	48				

INPUT DATA - PROJECT AK74

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S		
48	12	DO	DE	CHECK DWG SET	1	49		
49	10	DO	DR	DRAFTING REV 1	2	50	51	
50	03	DO	DE	DESIGN APPROVAL	1	52		
51	03	DO	DE	QUANTITY CALC	1	53		
52	05	DO	DR	DRAFTING REV 2	3	74	75	66
53	01	DO	DE	QUANTITY CALC CHECK	1	81		
61	03	MO		SUPERSTR DESIGN APPR	1	62		
62	12	MO		REQUISITION SUPPLY A	1	63		
63	01	MO		TENDER APPR A	2	64	76	
64	03	MO		CHECK SHOP DWGS A	1	65		
65	20	MO		FABRICATION INSP A	1	92		
66	06	MO		REQUISITION SUPPLY B	1	67		
67	01	MO		TENDER APPR B	1	68		
68	03	MO		CHECK SHOP DWGS B	1	69		
69	15	MO		FABRICATION INSP B	1	92		
71	00	CA		BTC NWA DWGS	1	72		
72	00	CA		BTC NWA SUBMISSION	1	73		
73	00	CA		BTC NWA APPROVAL	1	77		
74	03	CA		CHECK DWGS CONST	1	75		
75	01	CA		CHECK DWGS CONTRACT	1	76		
76	01	CA		CONTRACT SCH CONF	1	77		
77	02	CA		SPEC PROV DRAFTED	3	78	80	81
78	01	CA		SPEC PROV APPROVAL	1	79		
79	01	CA		REVISION OF DWGS	1	81		
80	02	CA		PERMISSION TO ADV	1	85		
81	01	CA		PREP SAMPLE CONTRACT	2	82	84	
82	01	CA		FINAL APPROVAL DWGS	1	83		
83	03	CA		DWG SETS PREPARED	1	85		
84	01	CA		CONTRACT ASSEMBLY	1	85		
85	13	CA		ADV PROCESS TENDERS	1	86		
86	15	CA		CONTRACT SIGNATURE	1	87		
87	09	CA		CONTRACT AWARD	1	91		
91	65	CO		CONSTRUCTION START	1	92		
92	65	CO		CONSTRUCTION FINISH	1	93		
93	12	CO		CONTRACT TERMINATION	0			

INPUT DATA - PROJECT GC621

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S				
1	00	PE		BRIDGE REQUEST	4	2	3	4	5	
2	06	PE		TRAFFIC ANALYSIS	1	6				
3	03	PE		FIELD RECONN	1	10				
4	05	PE		SITE SURVEY	1	7				
5	02	PE		OFFICE STUDY	1	10				
6	02	PE		TRAFFIC STUDY	1	10				
7	06	PE		PRELIM DESIGN START	5	8	9	10	11	12
8	02	PE		INTER BRANCH APPR	1	15				
9	00	PE		LOCAL AUTHORITY APPR	1	15				
10	06	PE		PRELIM DESIGN FINISH	1	13				
11	02	PE		DD DWGS START	1	14				
12	12	PE		FOUNDATION INVEST	1	37				
13	02	PE		RECONN REPORT	1	15				
14	02	PE		DD DWGS FINISH	1	20				
15	01	PE		RECONN REPORT APPR	3	16	17	18		
16	00	PE		BRIDGE SURVEY	2	19	20			
17	00	AR		RDWY SURVEY START	2	21	22			
18	00	AR		RDWY STANDARDS	1	23				
19	00	PE		RW PLANS BRIDGE	1	25				
20	01	PE		DD DWGS APPROVAL	2	31	32			
21	00	AR		RDWY SURVEY FINISH	1	23				
22	00	AR		RDWY DESIGN START	1	23				
23	00	AR		RDWY DESIGN FINISH	2	24	25			
24	00	AR		RDWY DESIGN APPROVAL	1	26				
25	00	AR	RW	RW PLANS RDWY	1	26				
26	00	AR	RW	RW PURCH AUTHORIZED	1	27				
27	00	AR	RW	RW ACQUIRED	1	77				
31	02	DO	DE	INITIAL DESIGN	1	33				
32	01	DO	DE	STRUC COST ESTIMATES	1	33				
33	01	DO	DE	STRUC PROP APPR	2	34	71			
34	01	DO	DE	PRELIM DETAILS	2	35	36			
35	00	DO	DE	SUPERSTR DESIGN	2	37	38			
36	02	DO	DR	GENERAL LAYOUT START	1	47				
37	03	DO	DE	PIER DESIGN	2	40	41			
38	00	DO	DR	SUPERSTR DWGS	3	39	48	61		
39	00	DO	DE	SUPERSTR DESIGN CH	1	74				
40	03	DO	DE	DECK ABUT DESIGN	3	43	44	45		
41	03	DO	DR	PIER DWGS	2	42	48			
42	01	DO	DE	PIER DESIGN CHECK	1	74				
43	03	DO	DR	ABUT DWGS	2	46	48			
44	00	DO	DR	DECK DWGS	2	46	48			
45	00	DO	DR	MISC DWGS	2	46	48			
46	01	DO	DE	DECK ABUT DESIGN CH	1	74				
47	02	DO	DR	GENERAL LAYOUT FIN	1	48				

INPUT DATA - PROJECT GC621

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT,S
48	03	DO	DE	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	01	DO	DE	DESIGN APPROVAL	1	52
51	02	DO	DE	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 66
53	01	DO	DE	QUANTITY CALC CHECK	1	81
61	01	MO		SUPERSTR DESIGN APPR	1	62
62	00	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 76
64	01	MO		CHECK SHOP DWGS A	1	65
65	00	MO		FABRICATION INSP A	1	92
66	06	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	01	MO		CHECK SHOP DWGS B	1	69
69	10	MO		FABRICATION INSP B	1	92
71	03	CA		BTC NWA DWGS	1	72
72	03	CA		BTC NWA SUBMISSION	1	73
73	40	CA		BTC NWA APPROVAL	1	77
74	01	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	01	CA		CONTRACT SCH CONF	1	77
77	01	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	01	CA		REVISION OF DWGS	1	81
80	01	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	01	CA		FINAL APPROVAL DWGS	1	83
83	02	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	13	CA		ADV PROCESS TENDERS	1	86
86	15	CA		CONTRACT SIGNATURE	1	87
87	09	CA		CONTRACT AWARD	1	91
91	20	CO		CONSTRUCTION START	1	92
92	20	CO		CONSTRUCTION FINISH	1	93
93	12	CO		CONTRACT TERMINATION	0	

INPUT DATA - PROJECT [illegible]

LABEL	DUR	CD1	CD2	DESCRIPTION	NFA	FOLLOWING ACT.S
48	03	DO	DF	CHECK DWG SET	1	49
49	02	DO	DR	DRAFTING REV 1	2	50 51
50	01	DO	DF	DESIGN APPROVAL	1	52
51	02	DO	DF	QUANTITY CALC	1	53
52	01	DO	DR	DRAFTING REV 2	3	74 75 [illegible]
53	01	DO	DF	QUANTITY CALC CHECK	1	81
61	01	MO		SUPERSTR DESIGN APPR	1	62
62	00	MO		REQUISITION SUPPLY A	1	63
63	01	MO		TENDER APPR A	2	64 74
64	01	MO		CHECK SHOP DWGS A	1	65
65	00	MO		FABRICATION INSP A	1	92
66	06	MO		REQUISITION SUPPLY B	1	67
67	01	MO		TENDER APPR B	1	68
68	01	MO		CHECK SHOP DWGS B	1	69
69	10	MO		FABRICATION INSP B	1	92
71	03	CA		BTC NWA DWGS	1	72
72	03	CA		BTC NWA SUBMISSION	1	73
73	40	CA		BTC NWA APPROVAL	1	77
74	01	CA		CHECK DWGS CONST	1	75
75	01	CA		CHECK DWGS CONTRACT	1	76
76	01	CA		CONTRACT SCH CONF	1	77
77	01	CA		SPEC PROV DRAFTED	3	78 80 81
78	01	CA		SPEC PROV APPROVAL	1	79
79	01	CA		REVISION OF DWGS	1	81
80	01	CA		PERMISSION TO ADV	1	85
81	01	CA		PREP SAMPLE CONTRACT	2	82 84
82	01	CA		FINAL APPROVAL DWGS	1	83
83	02	CA		DWG SETS PREPARED	1	85
84	01	CA		CONTRACT ASSEMBLY	1	85
85	13	CA		ADV PROCESS TENDERS	1	86
86	15	CA		CONTRACT SIGNATURE	1	87
87	09	CA		CONTRACT AWARD	1	91
91	20	CO		CONSTRUCTION START	1	92
92	20	CO		CONSTRUCTION FINISH	1	93
93	12	CO		CONTRACT TERMINATION	0	

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN THE INPUT ORDER

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
1	0	PE		*BRIDGE REQUEST	0	-0	0	0	0	0
2	6	PE		TRAFFIC ANALYSIS	0	3	6	9	-0	3
3	3	PE		FIELD RECONN	0	8	3	11	8	8
4	5	PE		*SITE SURVEY	0	-0	5	5	0	0
5	2	PE		OFFICE STUDY	0	9	2	11	9	9
6	2	PE		TRAFFIC STUDY	6	9	8	11	3	3
7	6	PE		*PRELIM DESIGN START	5	5	11	11	0	0
8	2	PE		INTER BRANCH APPR	11	17	13	19	6	6
9	0	PE		LOCAL AUTHORITY APPR	11	19	11	19	8	8
10	6	PE		*PRELIM DESIGN FINISH	11	11	17	17	0	0
11	2	PE		DD DWGS START	11	16	13	18	-0	5
12	12	PE		FOUNDATION INVEST	11	39	23	51	2	28
13	2	PE		*RECONN REPORT	17	17	19	19	0	0
14	2	PE		DD DWGS FINISH	13	18	15	20	5	5
15	1	PE		*RECONN REPORT APPR	19	19	20	20	0	0
16	0	PE		*BRIDGE SURVEY	20	20	20	20	0	0
17	0	AR		RDWY SURVEY START	20	70	20	70	-0	50
18	0	AR		RDWY STANDARDS	20	70	20	70	-0	50
19	0	PE		RW PLANS BRIDGE	20	70	20	70	-0	50
20	1	PE		*DD DWGS APPROVAL	20	20	21	21	0	0
21	0	AR		RDWY SURVEY FINISH	20	70	20	70	-0	50
22	0	AR		RDWY DESIGN START	20	70	20	70	-0	50
23	0	AR		RDWY DESIGN FINISH	20	70	20	70	-0	50
24	0	AR		RDWY DESIGN APPROVAL	20	70	20	70	-0	50
25	0	AR	RW	RW PLANS RDWY	20	70	20	70	-0	50
26	0	AR	RW	RW PURCH AUTHORIZED	20	70	20	70	-0	50
27	0	AR	RW	RW ACQUIRED	20	70	20	70	50	50
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN THE INPUT ORDER

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31
61	1	MO		SUPERSTR DESIGN APPR	25	67	26	68	-0	42
62	0	MO		REQUISITION SUPPLY A	26	68	26	68	-0	42
63	1	MO		TENDER APPR A	26	68	27	69	-0	42
64	1	MO		CHECK SHOP DWGS A	27	133	28	134	-0	106
65	0	MO		FABRICATION INSP A	28	134	28	134	106	106
66	6	MO		REQUISITION SUPPLY B	41	116	47	122	-0	75
67	1	MO		TENDER APPR B	47	122	48	123	-0	75
68	1	MO		CHECK SHOP DWGS B	48	123	49	124	-0	75
69	10	MO		FABRICATION INSP B	49	124	59	134	75	75
71	3	CA		*BTC NWA DWGS	24	24	27	27	0	0
72	3	CA		*BTC NWA SUBMISSION	27	27	30	30	0	0
73	40	CA		*BTC NWA APPROVAL	30	30	70	70	0	0
74	1	CA		CHECK DWGS CONST	41	67	42	68	-0	26
75	1	CA		CHECK DWGS CONTRACT	42	68	43	69	-0	26
76	1	CA		CONTRACT SCH CONF	43	69	44	70	26	26
77	1	CA		*SPEC PROV DRAFTED	70	70	71	71	0	0
78	1	CA		*SPEC PROV APPROVAL	71	71	72	72	0	0
79	1	CA		*REVISION OF DWGS	72	72	73	73	0	0
80	1	CA		PERMISSION TO ADV	71	76	72	77	5	5
81	1	CA		*PREP SAMPLE CONTRACT	73	73	74	74	0	0
82	1	CA		*FINAL APPROVAL DWGS	74	74	75	75	0	0
83	2	CA		*DWG SETS PREPARED	75	75	77	77	0	0
84	1	CA		CONTRACT ASSEMBLY	74	76	75	77	2	2
85	13	CA		*ADV PROCESS TENDERS	77	77	90	90	0	0
86	15	CA		*CONTRACT SIGNATURE	90	90	105	105	0	0
87	9	CA		*CONTRACT AWARD	105	105	114	114	0	0
91	20	CO		*CONSTRUCTION START	114	114	134	134	0	0
92	20	CO		*CONSTRUCTION FINISH	134	134	154	154	0	0
93	12	CO		*CONTRACT TERMINATION	154	154	166	166	0	0

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
1	0	PE		*BRIDGE REQUEST	0	-0	0	0	0	0
2	6	PE		TRAFFIC ANALYSIS	0	3	6	9	-0	3
3	3	PE		FIELD RECONN	0	8	3	11	8	8
4	5	PE		*SITE SURVEY	0	-0	5	5	0	0
5	2	PE		OFFICE STUDY	0	9	2	11	9	9
7	6	PE		*PRELIM DESIGN START	5	5	11	11	0	0
6	2	PE		TRAFFIC STUDY	6	9	8	11	3	3
8	2	PE		INTER BRANCH APPR	11	17	13	19	6	6
9	0	PE		LOCAL AUTHORITY APPR	11	19	11	19	8	8
10	6	PE		*PRELIM DESIGN FINISH	11	11	17	17	0	0
11	2	PE		DD DWGS START	11	16	13	18	-0	5
12	12	PE		FOUNDATION INVEST	11	39	23	51	2	28
14	2	PE		DD DWGS FINISH	13	18	15	20	5	5
13	2	PE		*RECONN REPORT	17	17	19	19	0	0
15	1	PE		*RECONN REPORT APPR	19	19	20	20	0	0
16	0	PE		*BRIDGE SURVEY	20	20	20	20	0	0
17	0	AR		RDWY SURVEY START	20	70	20	70	-0	50
18	0	AR		RDWY STANDARDS	20	70	20	70	-0	50
19	0	PE		RW PLANS BRIDGE	20	70	20	70	-0	50
20	1	PE		*DD DWGS APPROVAL	20	20	21	21	0	0
21	0	AR		RDWY SURVEY FINISH	20	70	20	70	-0	50
22	0	AR		RDWY DESIGN START	20	70	20	70	-0	50
23	0	AR		RDWY DESIGN FINISH	20	70	20	70	-0	50
24	0	AR		RDWY DESIGN APPROVAL	20	70	20	70	-0	50
25	0	AR	RW	RW PLANS RDWY	20	70	20	70	-0	50
26	0	AR	RW	RW PURCH AUTHORIZED	20	70	20	70	-0	50
27	0	AR	RW	RW ACQUIRED	20	70	20	70	50	50
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
71	3	CA		*BTC NWA DWGS	24	24	27	27	0	0
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42
61	1	MO		SUPERSTR DESIGN APPR	25	67	26	68	-0	42
62	0	MO		REQUISITION SUPPLY A	26	68	26	68	-0	42

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
63	1	MO		TENDER APPR A	26	68	27	69	-0	42
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
64	1	MO		CHECK SHOP DWGS A	27	133	28	134	-0	106
72	3	CA		*BTC NWA SUBMISSION	27	27	30	30	0	0
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
65	0	MO		FABRICATION INSP A	28	134	28	134	106	106
73	40	CA		*BTC NWA APPROVAL	30	30	70	70	0	0
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31
66	6	MO		REQUISITION SUPPLY B	41	116	47	122	-0	75
74	1	CA		CHECK DWGS CONST	41	67	42	68	-0	26
75	1	CA		CHECK DWGS CONTRACT	42	68	43	69	-0	26
76	1	CA		CONTRACT SCH CONF	43	69	44	70	26	26
67	1	MO		TENDER APPR B	47	122	48	123	-0	75
68	1	MO		CHECK SHOP DWGS B	48	123	49	124	-0	75
69	10	MO		FABRICATION INSP B	49	124	59	134	75	75
77	1	CA		*SPEC PROV DRAFTED	70	70	71	71	0	0
78	1	CA		*SPEC PROV APPROVAL	71	71	72	72	0	0
80	1	CA		PERMISSION TO ADV	71	76	72	77	5	5
79	1	CA		*REVISION OF DWGS	72	72	73	73	0	0
81	1	CA		*PREP SAMPLE CONTRACT	73	73	74	74	0	0
82	1	CA		*FINAL APPROVAL DWGS	74	74	75	75	0	0
84	1	CA		CONTRACT ASSEMBLY	74	76	75	77	2	2
83	2	CA		*DWG SETS PREPARED	75	75	77	77	0	0
85	13	CA		*ADV PROCESS TENDERS	77	77	90	90	0	0
86	15	CA		*CONTRACT SIGNATURE	90	90	105	105	0	0
87	9	CA		*CONTRACT AWARD	105	105	114	114	0	0
91	20	CO		*CONSTRUCTION START	114	114	134	134	0	0
92	20	CO		*CONSTRUCTION FINISH	134	134	154	154	0	0
93	12	CO		*CONTRACT TERMINATION	154	154	166	166	0	0

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
1	0	PE		*BRIDGE REQUEST	0	-0	0	0	0	0
4	5	PE		*SITE SURVEY	0	-0	5	5	0	0
7	6	PE		*PRELIM DESIGN START	5	5	11	11	0	0
10	6	PE		*PRELIM DESIGN FINISH	11	11	17	17	0	0
13	2	PE		*RECONN REPORT	17	17	19	19	0	0
15	1	PE		*RECONN REPORT APPR	19	19	20	20	0	0
16	0	PE		*BRIDGE SURVEY	20	20	20	20	0	0
20	1	PE		*DD DWGS APPROVAL	20	20	21	21	0	0
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
71	3	CA		*BTC NWA DWGS	24	24	27	27	0	0
72	3	CA		*BTC NWA SUBMISSION	27	27	30	30	0	0
73	40	CA		*BTC NWA APPROVAL	30	30	70	70	0	0
77	1	CA		*SPEC PROV DRAFTED	70	70	71	71	0	0
78	1	CA		*SPEC PROV APPROVAL	71	71	72	72	0	0
79	1	CA		*REVISION OF DWGS	72	72	73	73	0	0
81	1	CA		*PREP SAMPLE CONTRACT	73	73	74	74	0	0
82	1	CA		*FINAL APPROVAL DWGS	74	74	75	75	0	0
83	2	CA		*DWG SETS PREPARED	75	75	77	77	0	0
85	13	CA		*ADV PROCESS TENDERS	77	77	90	90	0	0
86	15	CA		*CONTRACT SIGNATURE	90	90	105	105	0	0
87	9	CA		*CONTRACT AWARD	105	105	114	114	0	0
91	20	CO		*CONSTRUCTION START	114	114	134	134	0	0
92	20	CO		*CONSTRUCTION FINISH	134	134	154	154	0	0
93	12	CO		*CONTRACT TERMINATION	154	154	166	166	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
84	1	CA		CONTRACT ASSEMBLY	74	76	75	77	2	2
2	6	PE		TRAFFIC ANALYSIS	0	3	6	9	-0	3
6	2	PE		TRAFFIC STUDY	6	9	8	11	3	3
11	2	PE		DD DWGS START	11	16	13	18	-0	5
14	2	PE		DD DWGS FINISH	13	18	15	20	5	5
80	1	CA		PERMISSION TO ADV	71	76	72	77	5	5
8	2	PE		INTER BRANCH APPR	11	17	13	19	6	6
3	3	PE		FIELD RECONN	0	8	3	11	8	8
9	0	PE		LOCAL AUTHORITY APPR	11	19	11	19	8	8
5	2	PE		OFFICE STUDY	0	9	2	11	9	9
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26
74	1	CA		CHECK DWGS CONST	41	67	42	68	-0	26
75	1	CA		CHECK DWGS CONTRACT	42	68	43	69	-0	26
76	1	CA		CONTRACT SCH CONF	43	69	44	70	26	26
12	12	PE		FOUNDATION INVEST	11	39	23	51	2	28
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42
61	1	MO		SUPERSTR DESIGN APPR	25	67	26	68	-0	42
62	0	MO		REQUISITION SUPPLY A	26	68	26	68	-0	42
63	1	MO		TENDER APPR A	26	68	27	69	-0	42
17	0	AR		RDWY SURVEY START	20	70	20	70	-0	50
18	0	AR		RDWY STANDARDS	20	70	20	70	-0	50
19	0	PE		RW PLANS BRIDGE	20	70	20	70	-0	50
21	0	AR		RDWY SURVEY FINISH	20	70	20	70	-0	50
22	0	AR		RDWY DESIGN START	20	70	20	70	-0	50
23	0	AR		RDWY DESIGN FINISH	20	70	20	70	-0	50
24	0	AR		RDWY DESIGN APPROVAL	20	70	20	70	-0	50
25	0	AR	RW	RW PLANS RDWY	20	70	20	70	-0	50
26	0	AR	RW	RW PURCH AUTHORIZED	20	70	20	70	-0	50
27	0	AR	RW	RW ACQUIRED	20	70	20	70	50	50
66	6	MO		REQUISITION SUPPLY B	41	116	47	122	-0	75
67	1	MO		TENDER APPR B	47	122	48	123	-0	75
68	1	MO		CHECK SHOP DWGS B	48	123	49	124	-0	75
69	10	MO		FABRICATION INSP B	49	124	59	134	75	75
64	1	MO		CHECK SHOP DWGS A	27	133	28	134	-0	106
65	0	MO		FABRICATION INSP A	28	134	28	134	106	106

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN ORDER OF FREE FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
1	0	PE		*BRIDGE REQUEST	0	-0	0	0	0	0
2	6	PE		TRAFFIC ANALYSIS	0	3	6	9	-0	3
4	5	PE		*SITE SURVEY	0	-0	5	5	0	0
7	6	PE		*PRELIM DESIGN START	5	5	11	11	0	0
10	6	PE		*PRELIM DESIGN FINISH	11	11	17	17	0	0
11	2	PE		DD DWGS START	11	16	13	18	-0	5
13	2	PE		*RECONN REPORT	17	17	19	19	0	0
15	1	PE		*RECONN REPORT APPR	19	19	20	20	0	0
16	0	PE		*BRIDGE SURVEY	20	20	20	20	0	0
17	0	AR		RDWY SURVEY START	20	70	20	70	-0	50
18	0	AR		RDWY STANDARDS	20	70	20	70	-0	50
19	0	PE		RW PLANS BRIDGE	20	70	20	70	-0	50
20	1	PE		*DD DWGS APPROVAL	20	20	21	21	0	0
21	0	AR		RDWY SURVEY FINISH	20	70	20	70	-0	50
22	0	AR		RDWY DESIGN START	20	70	20	70	-0	50
23	0	AR		RDWY DESIGN FINISH	20	70	20	70	-0	50
24	0	AR		RDWY DESIGN APPROVAL	20	70	20	70	-0	50
25	0	AR	RW	RW PLANS RDWY	20	70	20	70	-0	50
26	0	AR	RW	RW PURCH AUTHORIZED	20	70	20	70	-0	50
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26
61	1	MO		SUPERSTR DESIGN APPR	25	67	26	68	-0	42
62	0	MO		REQUISITION SUPPLY A	26	68	26	68	-0	42
63	1	MO		TENDER APPR A	26	68	27	69	-0	42
64	1	MO		CHECK SHOP DWGS A	27	133	28	134	-0	106
66	6	MO		REQUISITION SUPPLY B	41	116	47	122	-0	75

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

COMPLETE REPORT PROJECT GC621

REPORT OUTPUT IN ORDER OF FREE FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
67	1	MO		TENDER APPR B	47	122	48	123	-0	75
68	1	MO		CHECK SHOP DWGS B	48	123	49	124	-0	75
71	3	CA		*BTC NWA DWGS	24	24	27	27	0	0
72	3	CA		*BTC NWA SUBMISSION	27	27	30	30	0	0
73	40	CA		*BTC NWA APPROVAL	30	30	70	70	0	0
74	1	CA		CHECK DWGS CONST	41	67	42	68	-0	26
75	1	CA		CHECK DWGS CONTRACT	42	68	43	69	-0	26
77	1	CA		*SPEC PROV DRAFTED	70	70	71	71	0	0
78	1	CA		*SPEC PROV APPROVAL	71	71	72	72	0	0
79	1	CA		*REVISION OF DWGS	72	72	73	73	0	0
81	1	CA		*PREP SAMPLE CONTRACT	73	73	74	74	0	0
82	1	CA		*FINAL APPROVAL DWGS	74	74	75	75	0	0
83	2	CA		*DWG SETS PREPARED	75	75	77	77	0	0
85	13	CA		*ADV PROCESS TENDERS	77	77	90	90	0	0
86	15	CA		*CONTRACT SIGNATURE	90	90	105	105	0	0
87	9	CA		*CONTRACT AWARD	105	105	114	114	0	0
91	20	CO		*CONSTRUCTION START	114	114	134	134	0	0
92	20	CO		*CONSTRUCTION FINISH	134	134	154	154	0	0
93	12	CO		*CONTRACT TERMINATION	154	154	166	166	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
12	12	PE		FOUNDATION INVEST	11	39	23	51	2	28
84	1	CA		CONTRACT ASSEMBLY	74	76	75	77	2	2
6	2	PE		TRAFFIC STUDY	6	9	8	11	3	3
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
14	2	PE		DD DWGS FINISH	13	18	15	20	5	5
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
80	1	CA		PERMISSION TO ADV	71	76	72	77	5	5
8	2	PE		INTER BRANCH APPR	11	17	13	19	6	6
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
3	3	PE		FIELD RECONN	0	8	3	11	8	8
9	0	PE		LOCAL AUTHORITY APPR	11	19	11	19	8	8
5	2	PE		OFFICE STUDY	0	9	2	11	9	9
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42
76	1	CA		CONTRACT SCH CONF	43	69	44	70	26	26
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31
27	0	AR	RW	RW ACQUIRED	20	70	20	70	50	50
69	10	MO		FABRICATION INSP B	49	124	59	134	75	75
65	0	MO		FABRICATION INSP A	28	134	28	134	106	106

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

PRELIMINARY ENGINEERING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
1	0	PE		*BRIDGE REQUEST	0	-0	0	0	0	0
2	6	PE		TRAFFIC ANALYSIS	0	3	6	9	-0	3
3	3	PE		FIELD RECONN	0	8	3	11	8	8
4	5	PE		*SITE SURVEY	0	-0	5	5	0	0
5	2	PE		OFFICE STUDY	0	9	2	11	9	9
7	6	PE		*PRELIM DESIGN START	5	5	11	11	0	0
6	2	PE		TRAFFIC STUDY	6	9	8	11	3	3
8	2	PE		INTER BRANCH APPR	11	17	13	19	6	6
9	0	PE		LOCAL AUTHORITY APPR	11	19	11	19	8	8
10	6	PE		*PRELIM DESIGN FINISH	11	11	17	17	0	0
11	2	PE		DD DWGS START	11	16	13	18	-0	5
12	12	PE		FOUNDATION INVEST	11	39	23	51	2	28
14	2	PE		DD DWGS FINISH	13	18	15	20	5	5
13	2	PE		*RECONN REPORT	17	17	19	19	0	0
15	1	PE		*RECONN REPORT APPR	19	19	20	20	0	0
16	0	PE		*BRIDGE SURVEY	20	20	20	20	0	0
19	0	PE		RW PLANS BRIDGE	20	70	20	70	-0	50
20	1	PE		*DD DWGS APPROVAL	20	20	21	21	0	0

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

PRELIMINARY ENGINEERING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
1	0	PE		*BRIDGE REQUEST	0	-0	0	0	0	0
4	5	PE		*SITE SURVEY	0	-0	5	5	0	0
7	6	PE		*PRELIM DESIGN START	5	5	11	11	0	0
10	6	PE		*PRELIM DESIGN FINISH	11	11	17	17	0	0
13	2	PE		*RECONN REPORT	17	17	19	19	0	0
15	1	PE		*RECONN REPORT APPR	19	19	20	20	0	0
16	0	PE		*BRIDGE SURVEY	20	20	20	20	0	0
20	1	PE		*DD DWGS APPROVAL	20	20	21	21	0	0
2	6	PE		TRAFFIC ANALYSIS	0	3	6	9	-0	3
6	2	PE		TRAFFIC STUDY	6	9	8	11	3	3
11	2	PE		DD DWGS START	11	16	13	18	-0	5
14	2	PE		DD DWGS FINISH	13	18	15	20	5	5
8	2	PE		INTER BRANCH APPR	11	17	13	19	6	6
3	3	PE		FIELD RECONN	0	8	3	11	8	8
9	0	PE		LOCAL AUTHORITY APPR	11	19	11	19	8	8
5	2	PE		OFFICE STUDY	0	9	2	11	9	9
12	12	PE		FOUNDATION INVEST	11	39	23	51	2	28
19	0	PE		RW PLANS BRIDGE	20	70	20	70	-0	50

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

APPROACH ROAD DESIGN ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
17	0	AR		RDWY SURVEY START	20	70	20	70	-0	50
18	0	AR		RDWY STANDARDS	20	70	20	70	-0	50
21	0	AR		RDWY SURVEY FINISH	20	70	20	70	-0	50
22	0	AR		RDWY DESIGN START	20	70	20	70	-0	50
23	0	AR		RDWY DESIGN FINISH	20	70	20	70	-0	50
24	0	AR		RDWY DESIGN APPROVAL	20	70	20	70	-0	50
25	0	AR	RW	RW PLANS RDWY	20	70	20	70	-0	50
26	0	AR	RW	RW PURCH AUTHORIZED	20	70	20	70	-0	50
27	0	AR	RW	RW ACQUIRED	20	70	20	70	50	50

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

APPROACH ROAD DESIGN ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
17	0	AR		RDWY SURVEY START	20	70	20	70	-0	50
18	0	AR		RDWY STANDARDS	20	70	20	70	-0	50
21	0	AR		RDWY SURVEY FINISH	20	70	20	70	-0	50
22	0	AR		RDWY DESIGN START	20	70	20	70	-0	50
23	0	AR		RDWY DESIGN FINISH	20	70	20	70	-0	50
24	0	AR		RDWY DESIGN APPROVAL	20	70	20	70	-0	50
25	0	AR	RW	RW PLANS RDWY	20	70	20	70	-0	50
26	0	AR	RW	RW PURCH AUTHORIZED	20	70	20	70	-0	50
27	0	AR	RW	RW ACQUIRED	20	70	20	70	50	50

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

DESIGN ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

DESIGN ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

DESIGN ENGINEERING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

DESIGN ENGINEERING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
31	2	DO	DE	*INITIAL DESIGN	21	21	23	23	0	0
33	1	DO	DE	*STRUC PROP APPR	23	23	24	24	0	0
32	1	DO	DE	STRUC COST ESTIMATES	21	22	22	23	1	1
34	1	DO	DE	PRELIM DETAILS	24	50	25	51	-0	26
35	0	DO	DE	SUPERSTR DESIGN	25	51	25	51	-0	26
37	3	DO	DE	PIER DESIGN	25	51	28	54	-0	26
40	3	DO	DE	DECK ABUT DESIGN	28	54	31	57	-0	26
48	3	DO	DE	CHECK DWG SET	34	60	37	63	-0	26
50	1	DO	DE	DESIGN APPROVAL	39	65	40	66	-0	26
51	2	DO	DE	QUANTITY CALC	39	70	41	72	-0	31
53	1	DO	DE	QUANTITY CALC CHECK	41	72	42	73	31	31
46	1	DO	DE	DECK ABUT DESIGN CH	34	66	35	67	6	32
42	1	DO	DE	PIER DESIGN CHECK	31	66	32	67	9	35
39	0	DO	DE	SUPERSTR DESIGN CH	25	67	25	67	16	42

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

DESIGN DRAFTING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

DESIGN DRAFTING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
43	3	DO	DR	ABUT DWGS	31	57	34	60	-0	26
49	2	DO	DR	DRAFTING REV 1	37	63	39	65	-0	26
52	1	DO	DR	DRAFTING REV 2	40	66	41	67	-0	26
41	3	DO	DR	PIER DWGS	28	57	31	60	-0	29
44	0	DO	DR	DECK DWGS	31	60	31	60	3	29
45	0	DO	DR	MISC DWGS	31	60	31	60	3	29
36	2	DO	DR	GENERAL LAYOUT START	25	56	27	58	-0	31
47	2	DO	DR	GENERAL LAYOUT FIN	27	58	29	60	5	31
38	0	DO	DR	SUPERSTR DWGS	25	60	25	60	-0	35

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

MATERIALS ORDERING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
61	1	MO		SUPERSTR DESIGN APPR	25	67	26	68	-0	42
62	0	MO		REQUISITION SUPPLY A	26	68	26	68	-0	42
63	1	MO		TENDER APPR A	26	68	27	69	-0	42
64	1	MO		CHECK SHOP DWGS A	27	133	28	134	-0	106
65	0	MO		FABRICATION INSP A	28	134	28	134	106	106
66	6	MO		REQUISITION SUPPLY B	41	116	47	122	-0	75
67	1	MO		TENDER APPR B	47	122	48	123	-0	75
68	1	MO		CHECK SHOP DWGS B	48	123	49	124	-0	75
69	10	MO		FABRICATION INSP B	49	124	59	134	75	75

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

MATERIALS ORDERING ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
61	1	MO		SUPERSTR DESIGN APPR	25	67	26	68	-0	42
62	0	MO		REQUISITION SUPPLY A	26	68	26	68	-0	42
63	1	MO		TENDER APPR A	26	68	27	69	-0	42
66	6	MO		REQUISITION SUPPLY B	41	116	47	122	-0	75
67	1	MO		TENDER APPR B	47	122	48	123	-0	75
68	1	MO		CHECK SHOP DWGS B	48	123	49	124	-0	75
69	10	MO		FABRICATION INSP B	49	124	59	134	75	75
64	1	MO		CHECK SHOP DWGS A	27	133	28	134	-0	106
65	0	MO		FABRICATION INSP A	28	134	28	134	106	106

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

CONTRACT ADMINISTRATION ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
71	3	CA		*BTC NWA DWGS	24	24	27	27	0	0
72	3	CA		*BTC NWA SUBMISSION	27	27	30	30	0	0
73	40	CA		*BTC NWA APPROVAL	30	30	70	70	0	0
74	1	CA		CHECK DWGS CONST	41	67	42	68	-0	26
75	1	CA		CHECK DWGS CONTRACT	42	68	43	69	-0	26
76	1	CA		CONTRACT SCH CONF	43	69	44	70	26	26
77	1	CA		*SPEC PROV DRAFTED	70	70	71	71	0	0
78	1	CA		*SPEC PROV APPROVAL	71	71	72	72	0	0
80	1	CA		PERMISSION TO ADV	71	76	72	77	5	5
79	1	CA		*REVISION OF DWGS	72	72	73	73	0	0
81	1	CA		*PREP SAMPLE CONTRACT	73	73	74	74	0	0
82	1	CA		*FINAL APPROVAL DWGS	74	74	75	75	0	0
84	1	CA		CONTRACT ASSEMBLY	74	76	75	77	2	2
83	2	CA		*DWG SETS PREPARED	75	75	77	77	0	0
85	13	CA		*ADV PROCESS TENDERS	77	77	90	90	0	0
86	15	CA		*CONTRACT SIGNATURE	90	90	105	105	0	0
87	9	CA		*CONTRACT AWARD	105	105	114	114	0	0

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

CONTRACT ADMINISTRATION ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF TOTAL FLOAT TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
71	3	CA		*BTC NWA DWGS	24	24	27	27	0	0
72	3	CA		*BTC NWA SUBMISSION	27	27	30	30	0	0
73	40	CA		*BTC NWA APPROVAL	30	30	70	70	0	0
77	1	CA		*SPEC PROV DRAFTED	70	70	71	71	0	0
78	1	CA		*SPEC PROV APPROVAL	71	71	72	72	0	0
79	1	CA		*REVISION OF DWGS	72	72	73	73	0	0
81	1	CA		*PREP SAMPLE CONTRACT	73	73	74	74	0	0
82	1	CA		*FINAL APPROVAL DWGS	74	74	75	75	0	0
83	2	CA		*DWG SETS PREPARED	75	75	77	77	0	0
85	13	CA		*ADV PROCESS TENDERS	77	77	90	90	0	0
86	15	CA		*CONTRACT SIGNATURE	90	90	105	105	0	0
87	9	CA		*CONTRACT AWARD	105	105	114	114	0	0
84	1	CA		CONTRACT ASSEMBLY	74	76	75	77	2	2
80	1	CA		PERMISSION TO ADV	71	76	72	77	5	5
74	1	CA		CHECK DWGS CONST	41	67	42	68	-0	26
75	1	CA		CHECK DWGS CONTRACT	42	68	43	69	-0	26
76	1	CA		CONTRACT SCH CONF	43	69	44	70	26	26

FISCAL PROGRAM -19XX BRIDGE BRANCH, INITIAL DRAFT

CONSTRUCTION ACTIVITIES PROJECT GC621

REPORT OUTPUT IN ORDER OF EARLY START TIMES

LABEL	DUR	CD1	CD2	DESCRIPTION	ES	LS	EF	LF	FF	TF
91	20	CO		*CONSTRUCTION START	114	114	134	134	0	0
92	20	CO		*CONSTRUCTION FINISH	134	134	154	154	0	0
93	12	CO		*CONTRACT TERMINATION	154	154	166	166	0	0

APPENDIX C

BOARD OF TRANSPORT COMMISSIONERS APPROVAL

NAVIGABLE WATERS PROTECTION ACT APPROVAL

BOARD OF TRANSPORT COMMISSIONERS APPROVAL

The Board of Transport Commissioners, as set up under legislation of the Federal Government of Canada, are responsible for enforcing regulations respecting the construction, reconstruction and improvement of grade separations in respect of railways subject to their jurisdiction. Within their responsibility is the operation of the Railway Grade Crossing Fund out of which an apportionment of the structure cost may be made depending on the qualifications presented before the Board. The responsibility of the Board is to approve all structures under their jurisdiction and to set out the cost sharing formula as per the regulations for each of the parties concerned, namely the highway, railway and utility authorities.

The method of obtaining approval for a grade separation with respect to a railway is set out as follows according to Board regulations:

(a) Application shall be filed with the Secretary of the Board and must include three copies of a general plan duly signed, numbered and dated, which plan shall be drawn and detailed as per the standard requirements set out by the Board. If the application includes a request for a grant from the Fund, included with the application shall be a reasonably detailed estimate of the cost of the proposed

work as well as the names and addresses of the head offices of any utility companies or commissions whose facilities will be affected.

(b) Copies of the application shall be forwarded to the head of the railway company concerned and to each utility company or commission whose facilities will be affected.

(c) The railway company and utility companies concerned must then submit their considerations to the Board.

(d) Upon receipt of all necessary submissions, the Board requests an inspection of the site and subsequently judges on the cost sharing formula if pertaining. The Board regulations also include provisions and regulations on the responsibilities of the parties concerned with respect to design, construction and maintenance.

NAVIGABLE WATERS PROTECTION ACT APPROVAL

The Navigable Waters Protection Act is found in Volume III of the Revised Statues of Canada, 1952, Chapter 193. It was amended by Statutes of Canada, 1953 - 54, C. 37 and 1956, C. 41.

The purpose of the Act makes it illegal to build or place a "work" under, in, or over a navigable water, unless the Minister of Public Works has first approved the site and plan of the "work". A "work" is broadly defined as meaning any structure or device which could possibly interfere with navigation. The Act only applies to construction under, in, or over a navigable water. Construction above high water mark may always be commenced before approval.

Whether a water is a navigable water must be decided with respect to each case. No definition is given in the Act of a "navigable water" and the decision rests with the Courts. It is up to the owner of the "work" to decide whether an application should be made.

The procedure used for making an application, by the Bridge Branch of the Alberta Department of Highways, is as follows:

(a) Copies of the design date sheets or equivalent showing proposed work and proposed location are sent to the District Engineer, Department of Public Works, Edmonton, along with a request for preliminary approval.

(b) Upon receiving consent for commencement of construction by the Canadian Minister of Public Works, drawings and a written description of the site and work are prepared according to the regulations set out, and sent to the stated authorities for approval and registration. The number of copies of the drawings and statements required by each authority is outlined in the Act.

(c) Upon receiving approval from the Registrar of Land Titles, and after sending the specified copies of the drawings and description to the Chief of Legal Services, Department of Public Works, Ottawa, the work is advertised as specified in the Act.

(d) A Statutory Declaration as proof of advertising and copies of advertising are sent to the Chief of Legal Services.

Once consent for commencement of construction is received by the Bridge Branch, the remaining steps are more or less formal. These steps are not critical to the performance of the preconstruction activities.